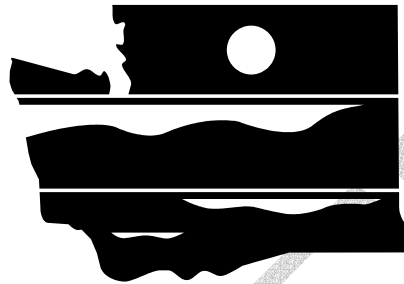


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North Fork Palouse River Fecal Coliform Bacteria Total Maximum Daily Load Recommendations

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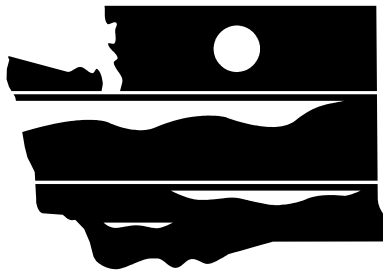
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WASHINGTON STATE
DEPARTMENT OF
E C O L O G Y

North Fork Palouse River Fecal Coliform Bacteria Total Maximum Daily Load Recommendations

by
Anise Ahmed

Environmental Assessment Program
Olympia, Washington 98504-7710

DRAFT – January 2004

Waterbodies: North Fork Palouse River (NX00WG (Old WA-34-1030))
Silver Creek (VW12BW)
Cedar Creek
Clear Creek

Publication No. 03-03-0??

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Abstract

A segment of the 34.3 mile-reach of the North Fork Palouse River within Washington boundaries (Colfax to Idaho border) is on the 303(d) list for fecal coliform bacteria. Within the North Fork Palouse River, fecal coliform bacterial concentrations in excess of the water quality criteria (geometric mean of 100 cfu/100 mL with 10 percent samples not to exceed 200 cfu/100 mL) have been documented. This report provides a comprehensive evaluation of fecal coliform bacteria data for the North Fork Palouse River and its tributaries. Target reductions for segments and mouths of tributaries and the mainstem are established to bring bacterial concentrations down to within water quality standards. The target reductions are based on the “statistical roll-back method”. A monitoring strategy is proposed to evaluate the effectiveness of the total maximum daily load implementation measures.

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- Karol Erickson for her review, and helpful comments on the report.
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Introduction

The North Fork Palouse River (NFPR) has been placed on Washington State's 303(d) list (1996, 1998, and proposed 2002) of impaired water bodies for not meeting the water quality standard for fecal coliform (FC) bacteria. Thus, under the Federal Clean Water Act of 1972, a cleanup plan must be developed and implemented to address these impairments and bring the waterbody segments into compliance with the standard. This report is a "total maximum daily load" (TMDL) technical document that contains the allowable loads of fecal coliform bacteria to ensure that the standard is met in all segments of the NFPR system at all times and locations under a reasonable worst case scenario.

The sources of fecal coliform bacteria in the NFPR Watershed are both point and non-point in nature. Two identified point sources in the watershed are the Palouse and Garfield municipal wastewater treatment systems. Potential non-point sources include failing on-site sewage treatment systems, livestock operations, hobby farms, stormwater, and wildlife. Non-point source FC reductions are achieved primarily through "best management practices" (BMPs).

Target pollutant reductions may be either in terms of concentration, or load, or both. For the NFPR Watershed, the TMDL is expressed in terms of FC concentration as allowed under Federal Regulations [40 CFR 130.2(I)] as "*other appropriate measures*." The concentration measure is appropriate since the water quality standard can be directly compared to measured FC in the receiving water under all flow scenarios. The "target reductions" show the reduction necessary in FC concentrations to achieve the water quality standard. Therefore the use of a flow rate to calculate the "daily loads" is unnecessary. However, loads at the mouths of tributaries and segments of the mainstem have been established to provide a relative comparison of contributions of FC from the different tributaries. Where applicable, seasonal or annual targets have been established. Segments of the mainstem and its tributaries where BMP implementation and monitoring needs to take place have been identified.

Background

The NFPR is a 54 mile long stream with headwaters in the Hoodoo Mountains of Idaho in Latah County, ending in the city of Colfax (Whitman County) in Washington, where it merges with the South Fork Palouse River (SFPR) (Figure 1). The NFPR drains approximately 495 square miles, of which 127 square miles are in Washington. The NFPR is part of the larger Palouse River Basin that drains approximately 3281 square miles and discharges its waters into the Snake River near the City of Hooper in Washington. The Snake River itself drains into the Columbia River as it travels to the Pacific Ocean. The segment of the Palouse River in Washington between the Idaho state line and Colfax is locally referred to as the North Fork Palouse River. From this point onwards all reference to NFPR would mean the segment between the Idaho/Washington stateline and the city of Colfax.

The 127 square mile NFPR drainage area in Washington consists of nearly 96% agricultural land; approximately 2% forested land, cliff areas and rock outcrops; less than 2% urban areas; less than 1% riparian/wetland areas; and less than 1% perennial and intermitten streams. The principal land use is dryland agriculture, with predominant crops being winter and spring wheat, spring barley, peas and lentils. The lowlands (areas adjacent to the stream and side tributaries) are primarily utilized as pasture (Resource Planning Unlimited, Inc, 2002).

The NFPR contributes about 83% of the mean annual flow of the Palouse River at Colfax, below the confluence with the south fork.

Major tributaries of the NFPR are Duffield, Cedar, Silver, and Clear creeks (Figure 2). All the creeks except Clear Creek originate in Idaho.

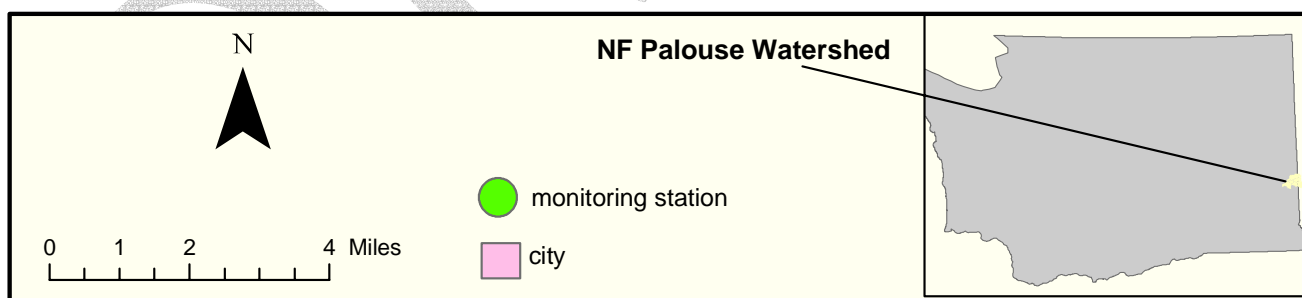
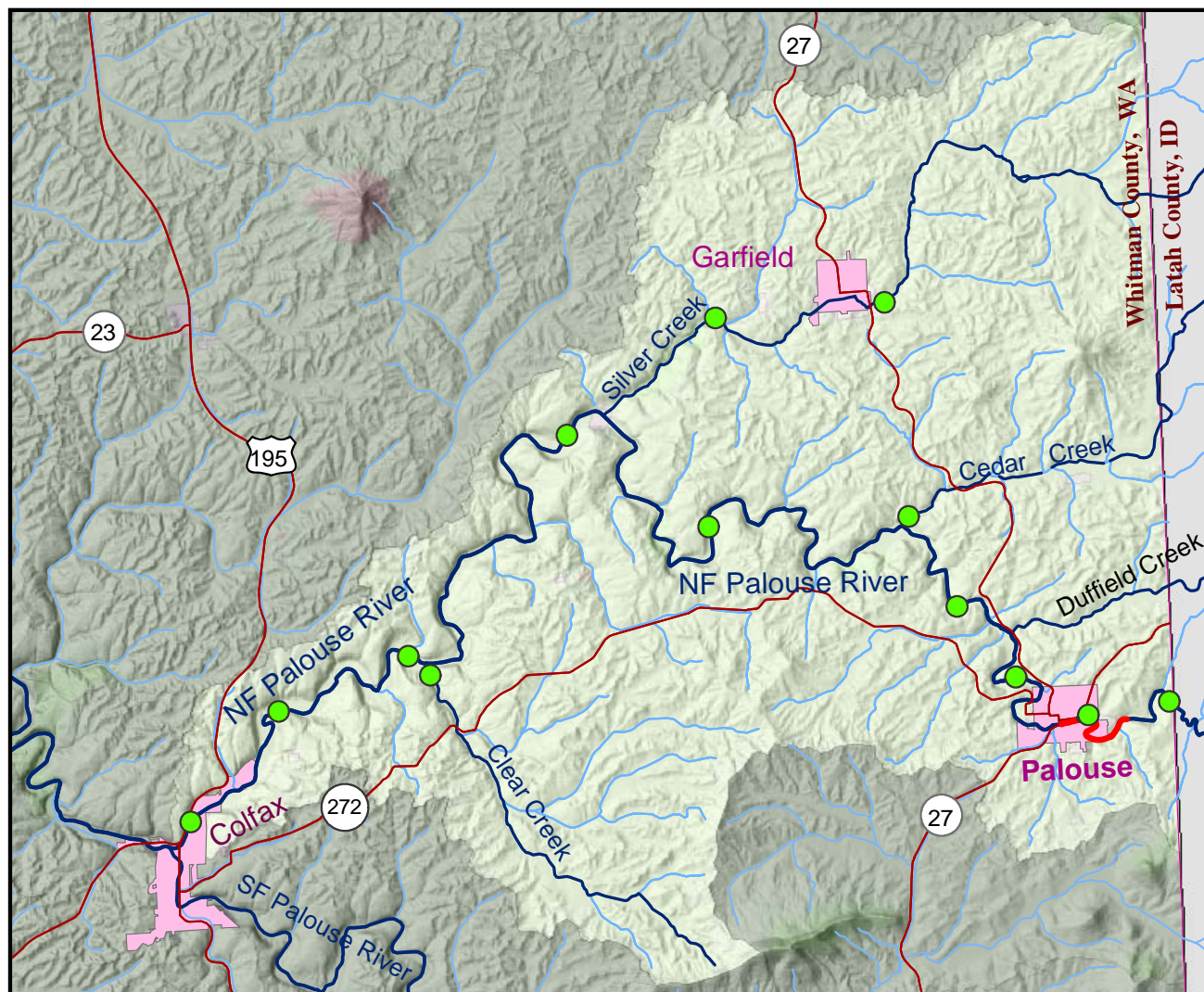


Figure 1. The North Fork Palouse Watershed

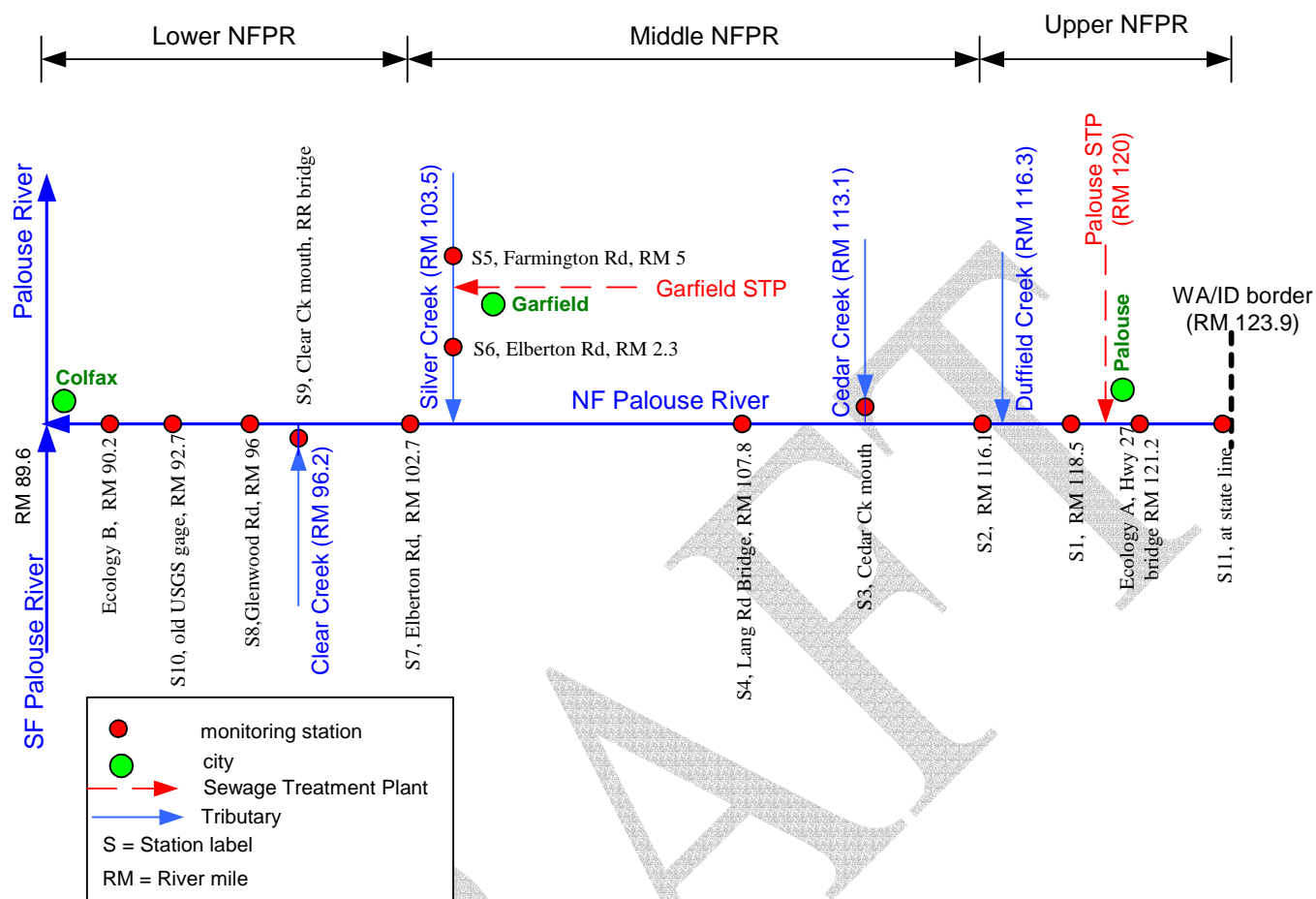


Figure 2. The North Fork Palouse River (NFPR), tributaries, point sources and monitoring stations

Applicable Criteria

The Water Quality Standards for Washington (WAC173-201A) designate the North Fork Palouse River and its tributaries as Class A (excellent) waters; the fecal coliform standard calls for a geometric mean of 100 colonies /100 mL with no more than 10 percent of samples greater than 200 colonies/100 mL. The characteristic beneficial uses designated for protection under this classification are: water supply; stock watering; fish migration; fish and shellfish rearing, spawning and harvesting; wildlife habitat; primary contact recreation; and commerce and navigation.

The new water quality standards rule (WAC173-201A) as adopted on July 1, 2003 (not yet approved by EPA), designates the 33.8 miles of North Fork Palouse River from Colfax (RM 89.6) to the Idaho border (RM 123.4) as having a primary contact recreational use (e.g., swimming and wading in the water) with the same fecal coliform standard as the old rule.

The coliform bacteria group consists of several genera of bacteria belonging to the family *enterobacteriaceae*. These mostly harmless bacteria are passed through the fecal excrement of humans, livestock, wildlife and domesticated animals. A specific subgroup of this collection is the fecal coliform bacteria, the most common member being *Escherichia coli*.

The presence of fecal coliform bacteria in aquatic environments indicates that the water has been contaminated with the fecal material of man or other animals. Fecal coliform bacteria can enter rivers through direct discharge of waste from mammals and birds, indirectly from agricultural and storm runoff, and from untreated human sewage. Residential or commercial on-site sewage treatment system failures may allow untreated human wastes to flow into drainage ditches and nearby waters. Agricultural practices such as animal wastes washing into nearby streams during the rainy season, spreading manure and fertilizer on fields during rainy periods, and allowing unrestricted livestock access to streams can all contribute to fecal coliform contamination.

While all fecal coliform bacteria do not directly cause disease, high quantities of fecal coliform bacteria suggest the presence of disease-causing agents. The presence of fecal contamination is an indicator that a potential health risk exists for individuals exposed to this water. Some waterborne pathogenic diseases include ear infections, dysentery, typhoid fever, viral and bacterial gastroenteritis, and hepatitis A.

Although fecal coliform bacterial die-off rates are not used in this report, nor is modeling done to show how bacteria migrate downstream, a short discussion on survival of microbes in the environment is presented here to portray the fact that microbes are not conservative pollutants but rather die in the environment. Factors that impact the survival of pathogens in streams include temperature, pH, ammonia, nutrients, ultra-violet (UV) radiation, and predation. Elevated temperatures can destroy viruses (Scheuerman et al., 1983), bacteria (Farrah and Bitton, 1983), and parasites (Kiff and Jones, 1984). Ward and Ashley (1977) showed that ammonia can be destructive to viruses. Watson (1980) noted that most enteric bacteria survive pH values between 5 and 8 and that outside this range they die rapidly. Under limiting substrate conditions microbes compete for the nutrient that is limiting and microbial growth rates decrease (Ahmed, 1990). UV radiation from sunlight is effective in the destruction of microorganisms that are near the surface of the water (Al-Azawi, 1986). However, the effectiveness of UV radiation reduces with increasing depth and turbidity. There is some evidence of fecal coliform regrowth in streams, particularly from chlorinated discharges after the chlorine has dissipated in the stream and/or when the discharge is dechlorinated prior to discharge (Rifai and Jensen 2002). There is also evidence of bacteria

settling to bottom of streams and becoming part of the sediment during low flow conditions and later re-suspending when flows become higher (Rifai and Jensen 2002). However, in relative terms, bacterial increase due to resuspension was more significant compared to regrowth. Protozoa are thought to be predators of coliform bacteria (Tate, 1978). Hay et al. (1990) noted that fecal coliform were more resistant to thermal inactivation than most enteric bacterial pathogens and the absence of this group generally indicated the destruction of most enteric bacterial pathogens.

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Water Quality and Resource Impairments

The North Fork Palouse River is listed under section 303(d) of the federal Clean Water Act. Table 1 shows the segment of the North Fork Palouse River included in the 303(d) list for 1996 and 1998 and that proposed for 2002/2004. These listings were based upon standard for fecal coliform bacteria in the old WAC173-201A and will not change with the new rules. This is because there is no numerical change in the standard as it applies to the listed segments.

Table 1. Stream segment in the North Fork Palouse River watershed on the 1996, 1998 and the proposed 2002 303(d) list for fecal coliform bacteria.

Stream	Waterbody ID (old)	Waterbody ID (new)	Segment	Proposed 2002	1998	1996
North Fork Palouse River	WA-34-1030	NXOOWG	2.62 mile segment near the town of Palouse Ecology station 34A170 (RM 121.2)	Yes	Yes	Yes

Historical data, Seasonal Variation, and Critical Conditions in North Fork Palouse River

Long-term fecal coliform and flow data are available at Ecology's station 34A170 (RM 121.2) above the town of Palouse. Figure 3 shows the long-term (1992-2003) monthly geometric mean and 90th percentile fecal coliform bacteria concentrations, the water quality standards for fecal coliform bacteria, and the mean monthly flows at this location. Maximum exceedence of the water quality standards occurred during lowest monthly flows in August. However, exceedence of the 90th percentile standard occurred in all months except, October, November and March.

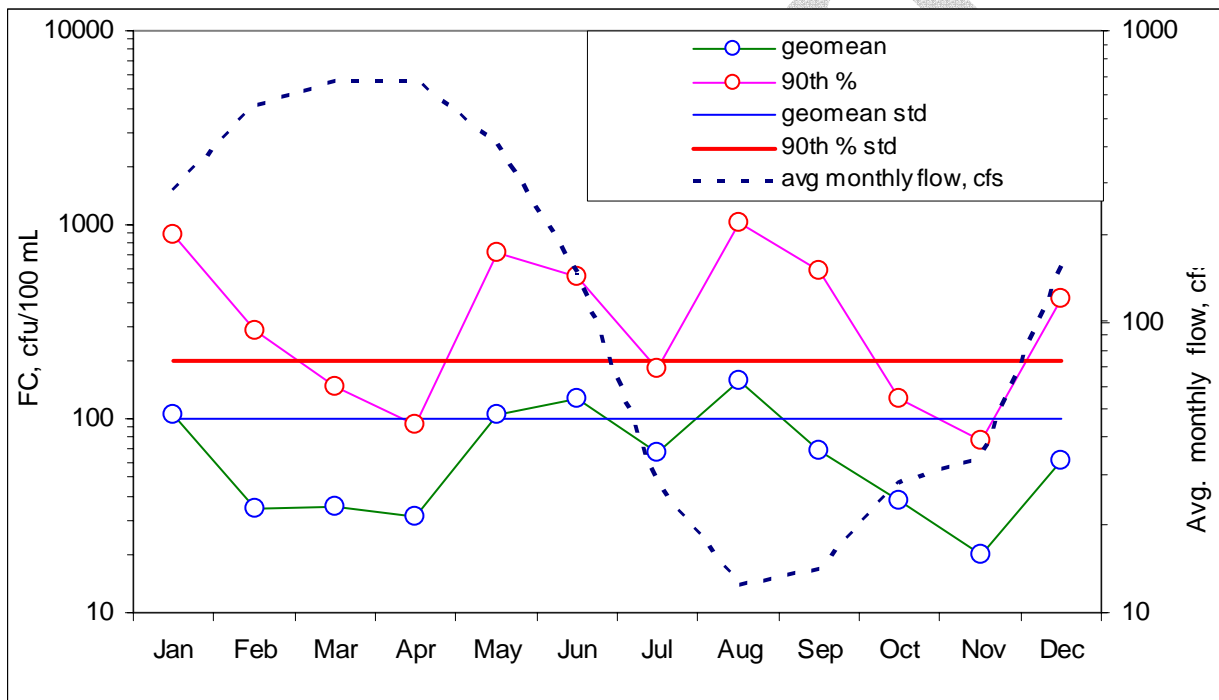


Figure 3. Historical (1992-2003) fecal coliform concentrations at Ecology's monitoring station (RM 121.2)

The Palouse Conservation District monitored the North Fork Palouse River and its tributaries during the 2001-2003 period for fecal coliform bacteria and flow, in addition to other parameters. In total, 11 stations were monitored. Figure 4 shows the overall distribution of the measured fecal coliform bacteria concentrations at these stations. FC data during conditions of no flow were not included in the analysis primarily because this would constitute a zero loading and secondarily because a "trickle" of water would not represent any "primary contact" beneficial use. Two (Clear and Silver creeks) of the four major creeks monitored showed overall exceedences of the water quality standards with Clear Creek showing the highest concentrations.

Seasonal variation in the concentration of FC bacteria has been considered in this TMDL by applying the water quality criteria to observed FC bacteria concentrations at monthly or seasonal intervals. The critical conditions determined to be appropriate for point source evaluation is the lowest 7-day average flow with a recurrence interval of 1 in 10 years (also known as 7Q10 flow). Dilution factors used in the existing NPDES permits for the point sources have been based on the 7Q10 stream flows. The critical conditions for non-point sources may occur during high-rainfall periods, particularly during the start of a rainfall event

when bacteria is “flushed” from surface soils into the streams. The critical condition can also be during dry weather resulting from ground water seepage contaminated by failing on-site sewage treatment systems and/or stream access by livestock and/or wildlife.

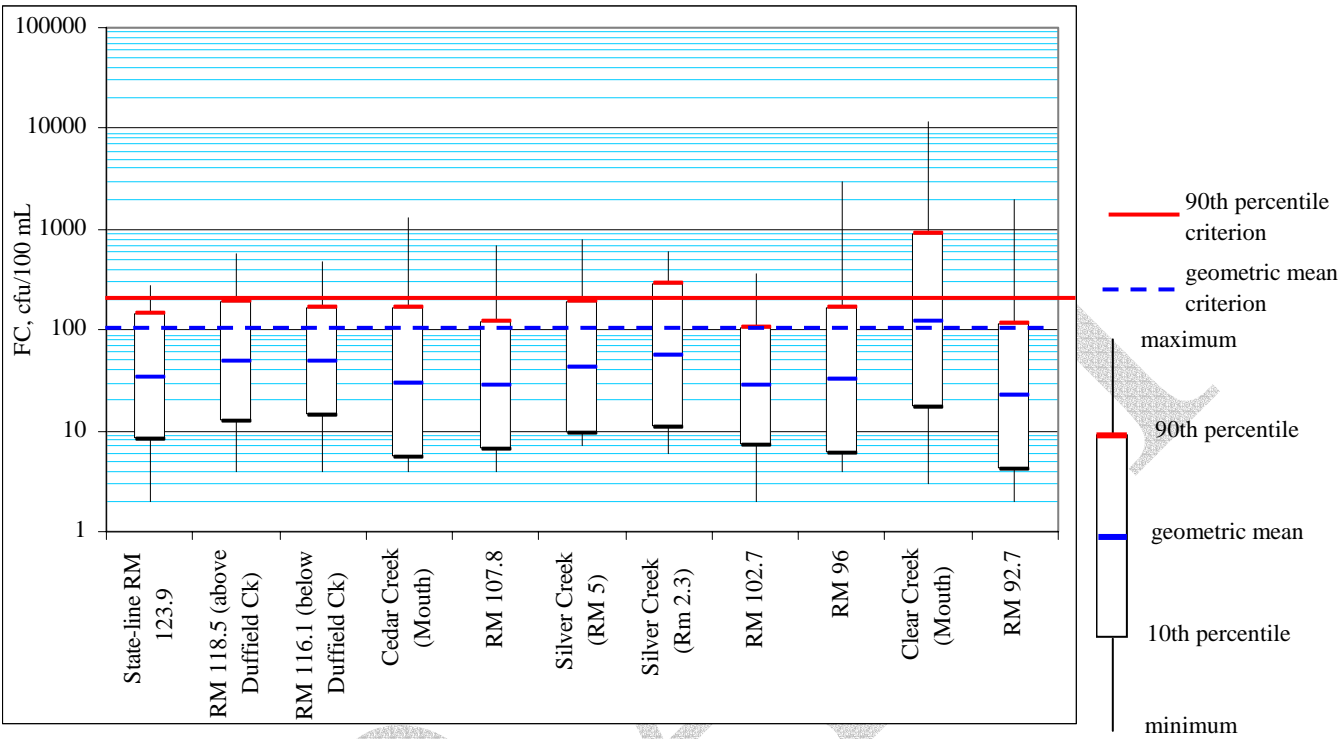


Figure 4. Geometric mean and 90th percentile fecal coliform concentrations at the various stations monitored during the 2001-2003 Palouse Conservation District study

Technical Analysis

The technical analysis is based upon analysis of historical and recent field data. Historical data were obtained from Ecology's "Environmental Information Management" database. Recent data were obtained from the Palouse Conservation District.

Excel® spreadsheets were used to evaluate the data, including mass balances, statistical analyses and plots.

The statistical roll-back method (Ott, 1995) was employed to establish fecal coliform bacteria reduction targets for the various segments of the mainstem and the tributaries. This method has been employed in Washington TMDLs by Roberts (2003), Coots (1994), Joy (2000), and Pelletier and Seiders (2000).

The roll-back method assumes that the distribution of fecal coliform bacteria concentrations follows a log-normal distribution. The cumulative probability plot of the observed data gives an estimate of the geometric mean and 90th percentile which can then be compared to the fecal coliform bacteria standards. The roll-back procedure is as follows:

- a) When data are plotted on a log-scale against a linear cumulative probability function, a straight line signifies a log-normal distribution of the data.
- b) The geometric mean of the data has a cumulative probability of 0.5
- c) The 90th percentile of the data has a cumulative probability of 0.9. This is equivalent to the "no more than 10% samples exceeding ..." criterion in the fecal coliform standard (WAC 173-201A).
- d) Alternately, the 90th percentile can also be estimated by using the following statistical equation:

$$90^{\text{th}} \text{ percentile} = 10^{(\mu_{\log} + 1.281552 * \sigma_{\log})}$$

where: μ_{\log} = mean of the log transformed data

σ_{\log} = standard deviation of the log transformed data

- e) The target percent reduction required is the highest of the following two comparisons.

either: $\left[\frac{\text{observed } 90^{\text{th}} \text{ percentile} - 200 \text{ cfu} / 100\text{mL}}{\text{observed } 90^{\text{th}} \text{ percentile}} \right] \times 100$

or: $\left[\frac{\text{observed geometric mean} - 100 \text{ cfu} / 100\text{mL}}{\text{observed geometric mean}} \right] \times 100$

- f) As "best management practices" for non-point sources and treatment technologies for point sources are implemented and the target reductions are achieved, a new but similar distribution (same coefficient of variation) of the data is assumed to be realized with the previous mean and standard deviation reduced by the target percent reductions.

- g) If the 90th percentile is limiting, then the goal would be to meet a 90th-percentile FC of 200 cfu/100 mL, and no goals would be set for the geometric mean since, with the implementation of the target reductions, the already low geometric mean (<100 cfu/100mL) would only get better. Similarly, if the geometric mean is limiting, the goal would be to achieve a geometric mean of 100 cfu/100mL with no goal for the already low (<200 cfu/100mL) 90th percentile.

The procedures and assumptions discussed above were used to evaluate FC data in the respective segments of the mainstem NFPR and tributaries to establish target bacterial reductions necessary to meet water quality standards. This is discussed in the following section.

Load Allocations

The Mainstem North Fork Palouse River (NFPR) addressed in this document extends from the mouth of the NFPR (RM 89.6) to the ID/WA border (RM 123.9). Several stations have been monitored along this reach for fecal coliform bacteria by the Palouse Conservation District and Ecology. Data from these stations will be evaluated, discussed, and target reductions developed in the following sections. In this TMDL it is assumed that if the individual tributaries and the various segments of the mainstem NFPR were to meet the water quality standard, the NFPR as a whole will meet the standard prior to its confluence with the South Fork Palouse River. For convenience the NFPR has been divided into three segments (see Figure 2):

1. Upper Mainstem Segment (ID/WA Border to Duffield Creek), RM 123.9 – RM 116.1
2. Middle Mainstem Segment (Duffield Creek to Silver Creek), RM 116.1 – 102.7
3. Lower Mainstem Segment (Silver Creek to mouth of NF Palouse River), RM 102.7 – RM 89.6

The target fecal coliform reductions necessary in these segments and associated tributaries to achieve water quality standards are discussed below.

Upper NFPR (ID/WA Border to below Duffield Creek), RM 123.9 – RM 116.1

This segment extends from the Washington/Idaho border (RM 123.9) to below Duffield Creek. There are four mainstem monitoring stations located in this segment (Figure 5). The Palouse STP also discharges to the NFPR in this reach. Data from these stations and the STP are discussed below.

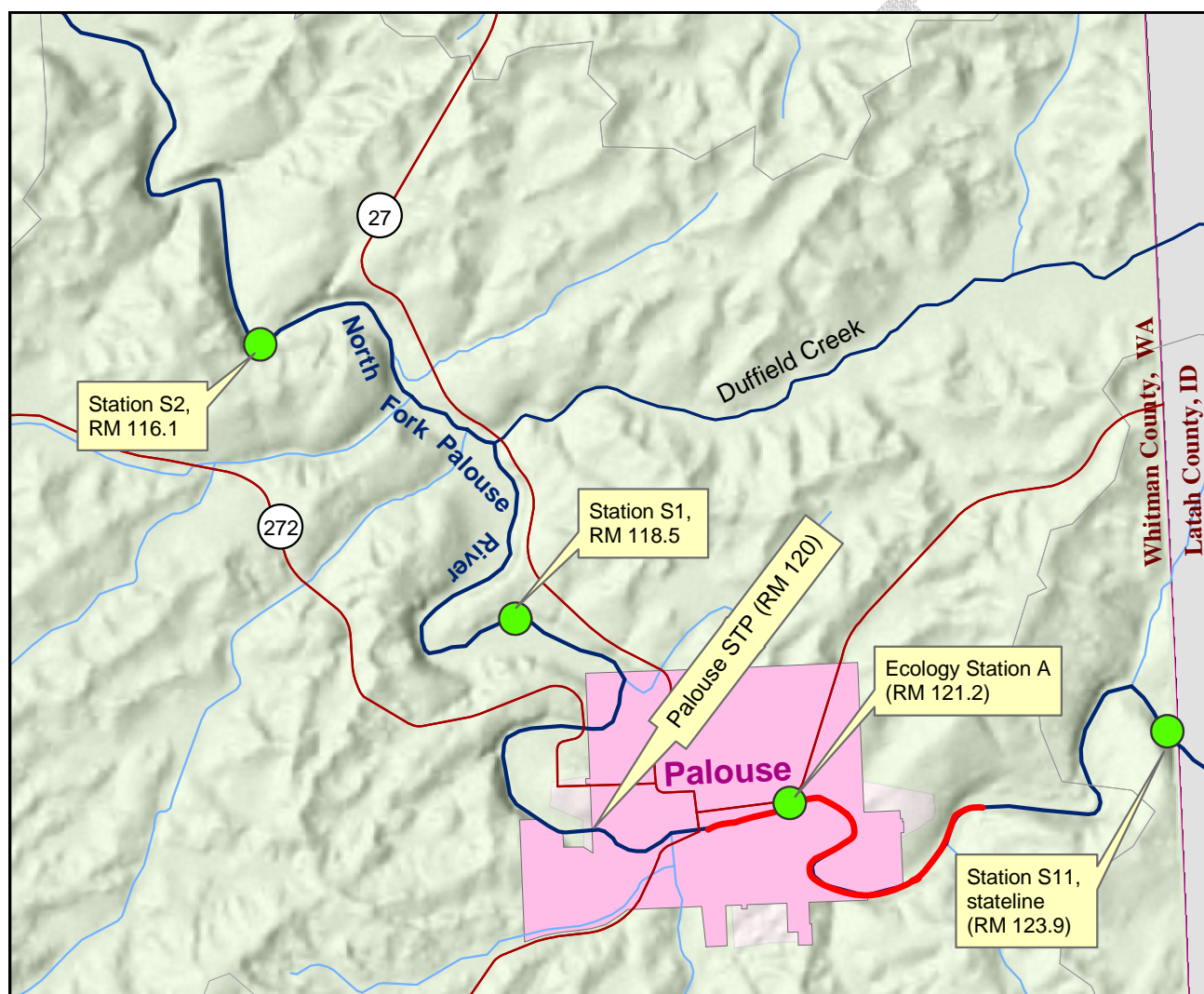
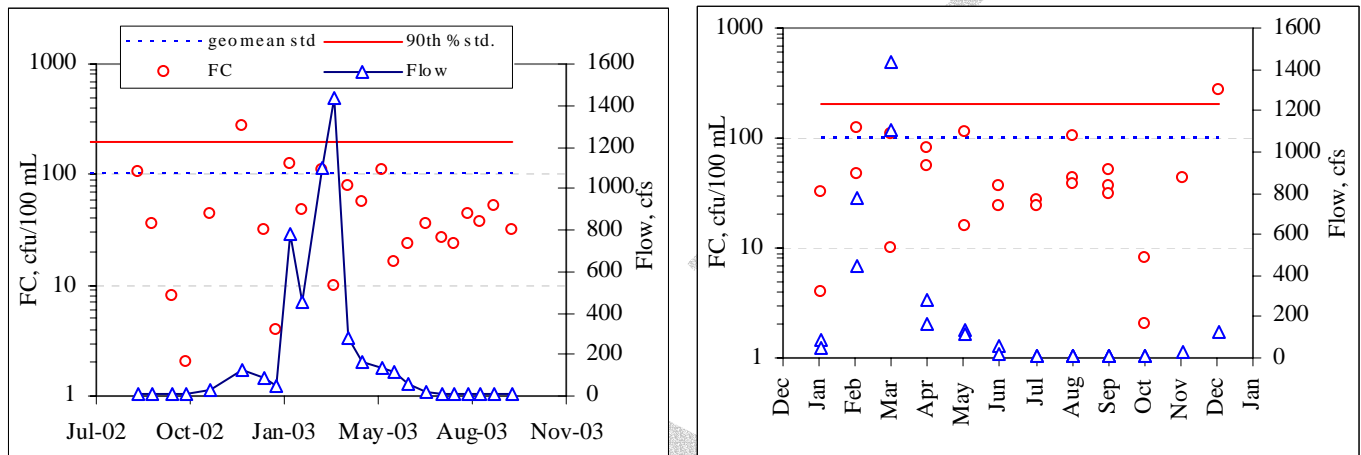


Figure 5. Locations of sampling stations and Palouse STP in the Upper NFPR segment

RM 123.9 (WA/ID stateline: Station 11)

The Palouse Conservation District measured fecal coliform bacteria concentrations at Station 11 (just west of the stateline) on a monthly basis from August, 2002 through September, 2003. This station was added in the second year of the study period. No flows were measured. However, due to its close proximity to Ecology Station A (RM 121.2), flows were assumed to be similar for the two stations. Figure 6 shows the

fecal coliform bacteria concentrations and distribution during this period. A seasonal variation is not apparent from Figure 6(b). This could be due to insufficient data (e.g. only one data point was available for November and December). Figure 7 shows the overall distribution of fecal coliform bacteria at this station. Both the geometric mean and the 90th-percentile concentrations are within the water quality standards. However, this station (RM 123.9) should be monitored to establish seasonal variation and potential target reductions in FC concentrations. For now, the seasonal target reduction established at Ecology Station A (RM 121.2) should serve as a guide on the level of BMPs necessary in this reach.



(a) variation of FC and flow during the study period

(b) monthly variation in FC and flow

Figure 6. Fecal coliform bacteria concentrations in the mainstem NFPR near the WA/ID border (RM 123.9)

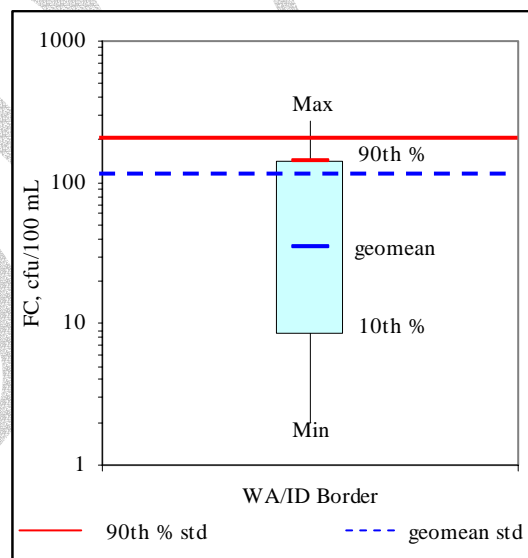


Figure 7. FC distribution at Mainstem NFPR RM 123.9 (WA/ID border)

RM 121.2: Above City of Palouse (Ecology Station A)

This station is located above the City of Palouse at RM 121.2. Ecology has monitored this station on a monthly basis since 1992. Exceedences of the water quality standards were observed through out the monitoring period and at all flows (Figure 8). On a year-to-year basis, the annual 90th percentile concentrations showed consistently high fecal coliforms (Figure 9). In order to establish a critical month with highest fecal coliform concentrations, long-term monthly geometric means and 90th percentiles were estimated as shown in Figure 10. The long-term monthly geometric mean and 90th-percentile FC concentrations exceed standards in both winter (Dec-Feb) and summer (May-Sept) seasons. The critical month with the highest exceedence is August. Figure 11 shows a log-normal FC distribution in this month. The target reduction based on long-term August concentrations is shown in Table 2.

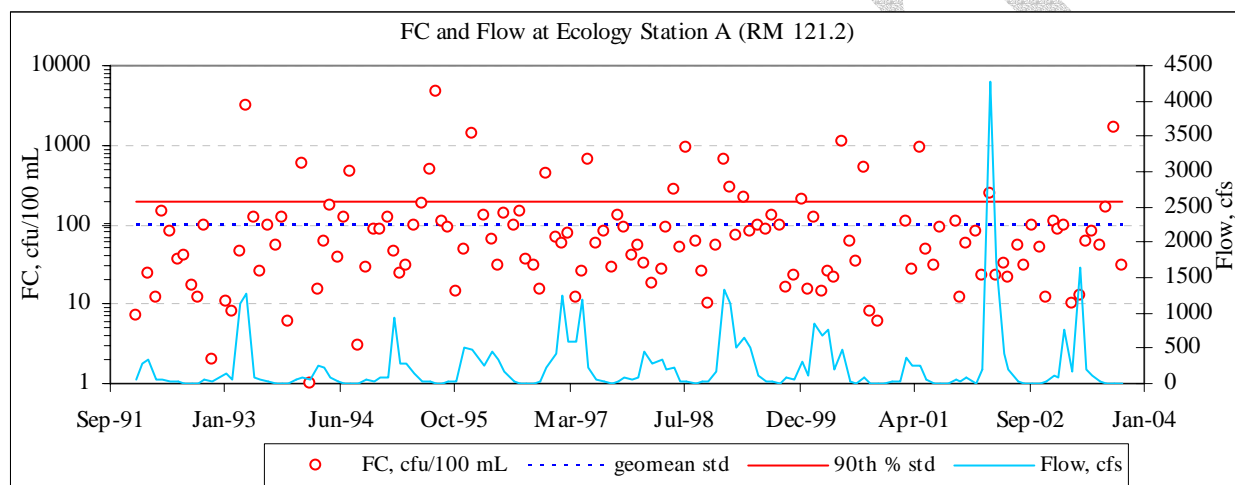


Figure 8. Fecal coliform bacteria concentrations and flow in the mainstem NFPR at RM 121.2 (Ecology station 34A170).

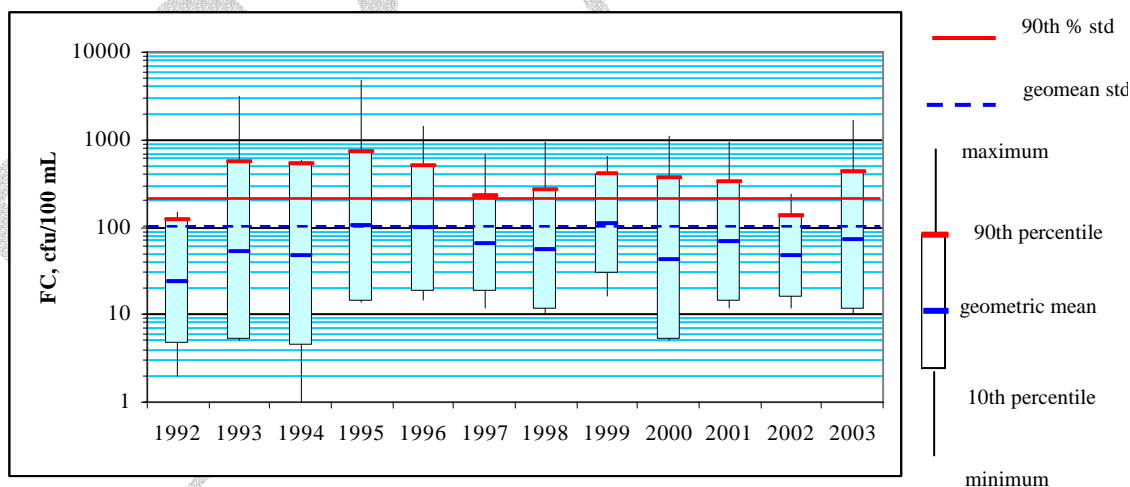


Figure 9. Annual distribution of fecal coliform bacteria in mainstem NFPR at RM 121.2 (Ecology station 34A170) 1992-2003

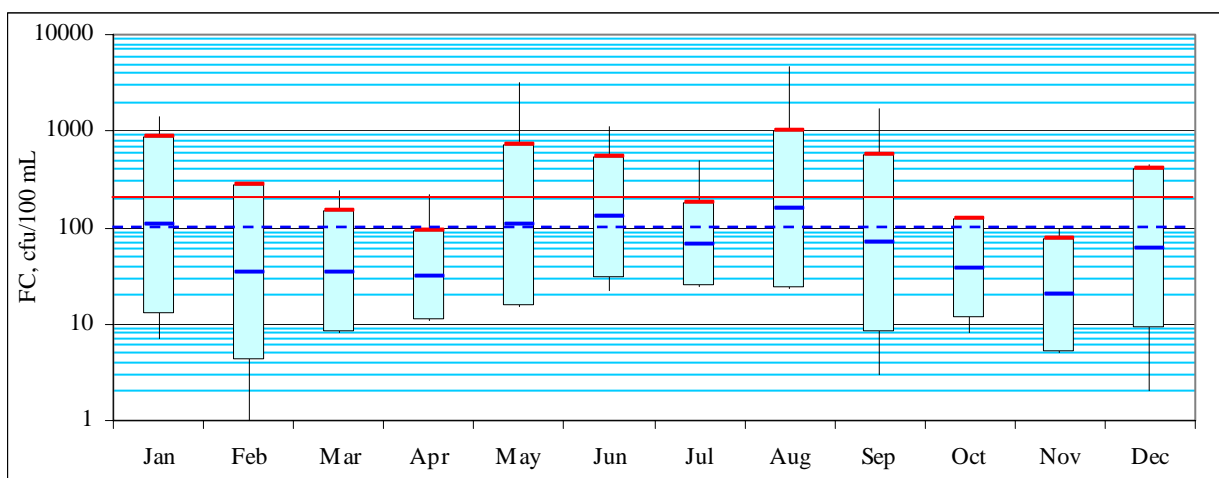


Figure 10. Seasonal fecal coliform bacteria concentrations in the mainstem NFPR at RM 121.2 (Ecology station 34A170) 1992-2003

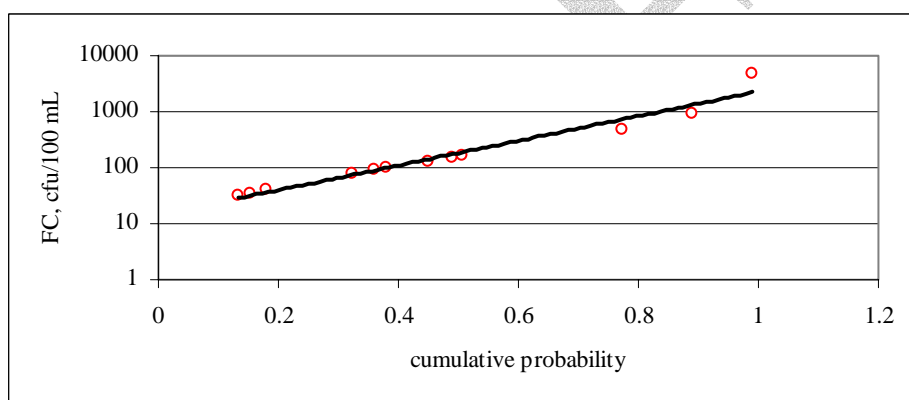


Figure 11. Cumulative probability plot for fecal coliform bacteria concentrations in the mainstem RM 121.2 (Ecology station 34A170) for August 1992-2003

Table 2. Target fecal coliform concentration reductions in the mainstem NFPR at RM 121.2 (Ecology station 34A170)

Station	Period considered	Number of samples	Geometric Mean (cfu/100 mL)	90 th Percentile (cfu/100 mL)	Limiting basis for reduction	Target Reduction (%)
RM 121.2	August	12	156	1022	90 th percentile	80

With an average flow of 12 cfs in August and the 90th percentile concentration of 1022 cfu/ 100 mL, the existing FC load at RM 121.2 is 3×10^{11} cfu/day. The FC load following achievement of water quality standard (i.e. 200 cfu/100 mL after 80% reduction) is 6×10^{10} cfu/day.

As indicated earlier, exceedence of the 90th-percentile FC standard has been observed in both the winter (Dec-Jan) and summer (May-Sept) seasons (Figure 10) at RM 121.2. Flow regimes and associated FC sources can be very different during these two periods. Both these periods should therefore be monitored. The station at this location is monitored monthly by Ecology on a long-term basis. It is recommended that this station be continued to be monitored as BMPs are implemented.

City of Palouse Municipal Wastewater Treatment Plant (RM 120)

The facility was issued NPDES permit No. WA-004480-6 in 2000. The permit contains effluent limits for fecal coliform bacteria of 100 cfu/100 mL and 200 cfu/100 mL as weekly and monthly geometric means, respectively. This is equivalent to meeting the water quality standards at “end-of-pipe”. In addition, the facility has a 300-ft mixing zone at its outfall in NF Palouse River with a dilution factor of 1.5 at the edge of the chronic zone. The loading from the plant based on a maximum monthly design flow of 0.28 MGD and the monthly geometric mean limit of 200 cfu/100 mL is 2.1×10^9 cfu/day. Evaluation of monthly discharge monitoring reports over the last three years (2001-2003) showed 100% compliance with the monthly geometric mean limit and 85% compliance with the weekly geometric mean limit (Figure 12).

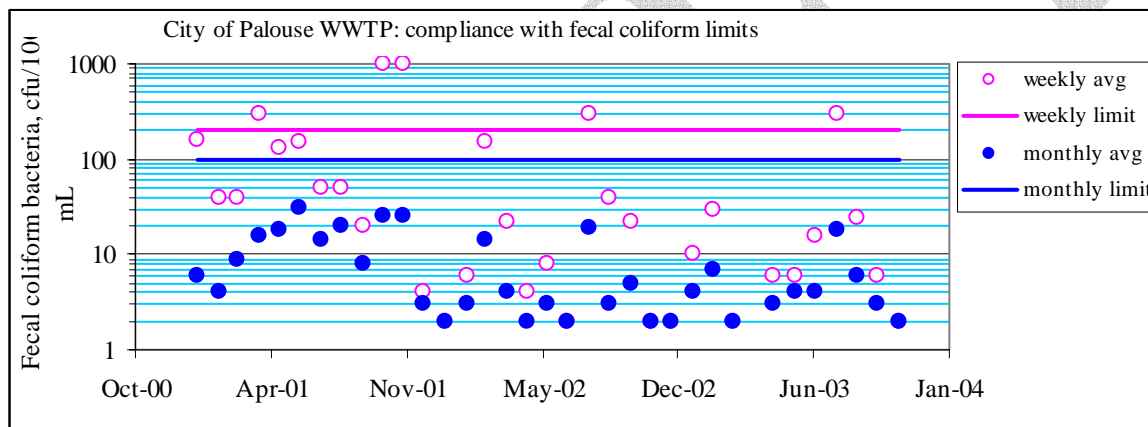
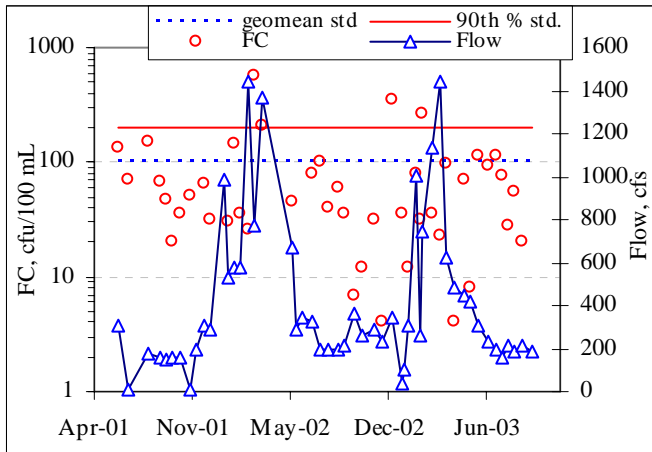


Figure 12. Fecal coliform concentrations in City of Palouse WWTP effluent (2001-2003)

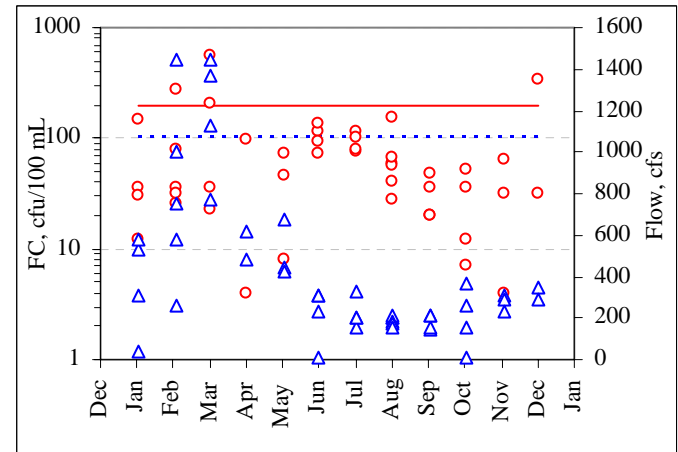
RM 118.5 and RM 116.1: Duffield Creek and NFPR (Stations 1 and 2)

Duffield Creek (mouth at mainstem RM 116.3) drains approximately 5,400 acres of primarily crop land with 64% of the land in Latah County, Idaho, and the rest in Whitman County, Washington. The creek consists of 9 miles of intermittent stream, tributaries and water ways. Ninety percent of the land is agricultural, 9% is used for grazing, and 1% is urban area (Resource Planning Unlimited, Inc, 2002).

Although direct measurements for fecal coliform bacteria were not made at the mouth of the creek, the Palouse Conservation District measured both flow and fecal coliform bacteria concentrations in the mainstem NFPR above (RM118.5, Station 1) and below (RM 116.1, Station 2) Duffield Creek between June, 2001 through September, 2003. Figures 13 and 14 show the fecal coliform concentrations and distribution during this period for these two stations. Seasonal variation in FC concentrations (Figures 13(b) and 14(b)) indicate that concentrations are high in both summer and winter seasons with the highest concentrations observed in December and March.

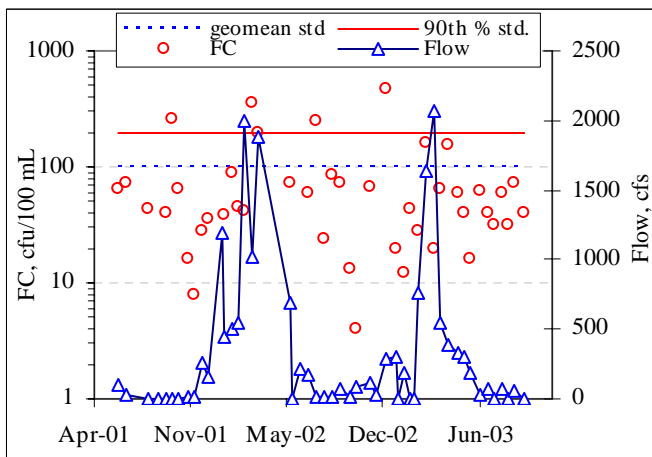


(a) variation of FC and flow during the study period

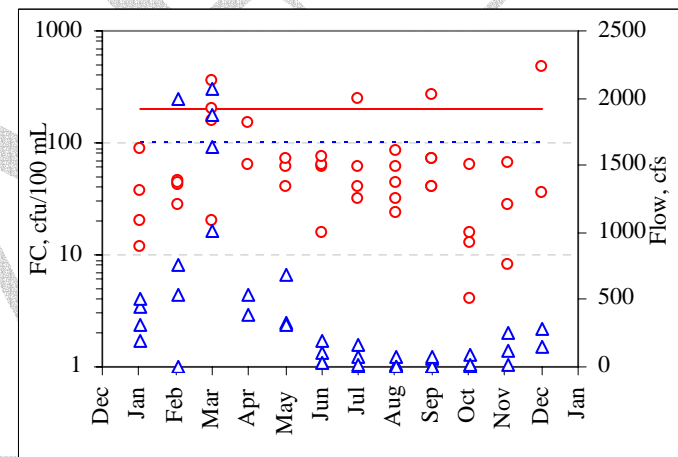


(b) monthly variation in FC and flow

Figure 13. Fecal coliform bacteria concentrations in mainstem NFPR RM 118.5 (Station 1), above Duffield Creek



(a) variation of FC and flow during the study period



(b) monthly variation in FC and flow

Figure 14. Fecal coliform bacteria concentrations in mainstem NFPR RM 116.1 (Station 2), below Duffield Creek

The two distinct periods (June-September and December-March) were evaluated to establish target reductions due to different flow regimes and associated, potentially different, sources of FC (Figures 15 and 16). Both the geometric mean and the 90th percentile concentrations are within the standards during the June through September period. However, the 90th percentile standard is exceeded during the December through March period.

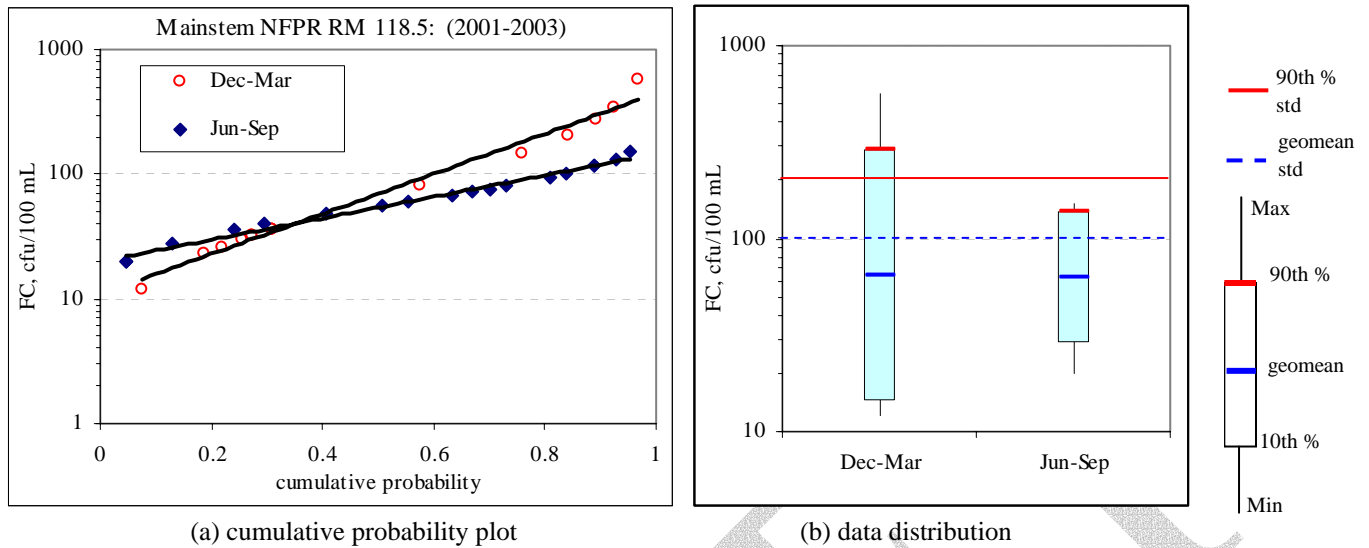


Figure 15. Cumulative probability plot for fecal coliform bacteria concentrations at Station 1 (above Duffield Creek) in the mainstem NFPR (RM 118.5)

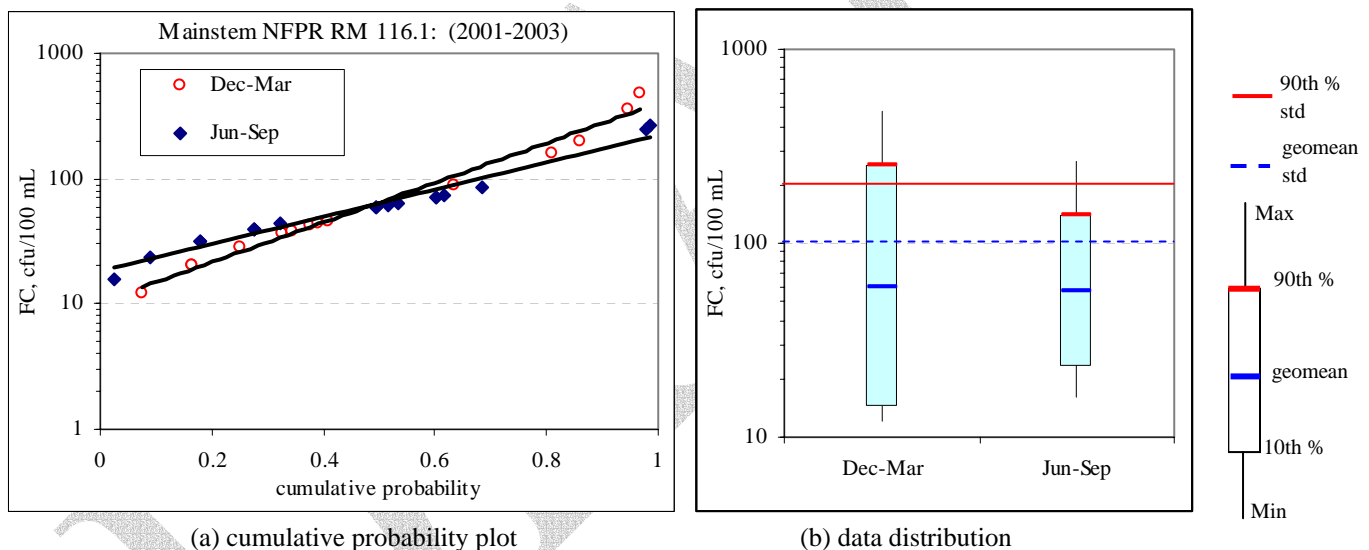


Figure 16. Cumulative probability plot for fecal coliform bacteria concentrations at Station 2 (below Duffield Creek) in the mainstem NFPR (RM 116.1)

Table 3 shows the respective target reductions required during the December-March period. The geometric mean and the 90th percentile concentrations at Stations 2 are lower than that at Station 1, suggesting that Duffield Creek is not a significant source of fecal coliform bacteria. To further evaluate whether there is a significant difference between the concentrations of fecal coliform bacteria measured at Stations 1 and 2, a paired t-test was done. The probability that the difference in concentrations at the two stations was no different than zero was 86%, suggesting an insignificant addition from Duffield Creek.

Table 3. Target fecal coliform concentration reductions at Station 1 and Station 2 in the mainstem NFPR

Station	Period considered	Number of samples	Geometric Mean (cfu/100 mL)	90 th Percentile (cfu/100 mL)	Limiting basis for reduction	Target Reduction (%)
Station 1 (RM 118.5)	Dec-Mar	15	64	286	90 th percentile	30
Station 2 (RM 116.1)	Dec-Mar	14	60	252	90 th percentile	21

Figure 17 shows that flow at Station 2 is relatively higher than Station 1 during fall, winter, and spring, but lower in summer. The high spring flow at Station 2 is due to flow added by Duffield Creek. Duffield Creek is an intermittent stream with little or no flow in the summer/fall season but high flow in spring. The low summer/fall flow at Station 2 is likely due to water withdrawals and/or water loss to groundwater.

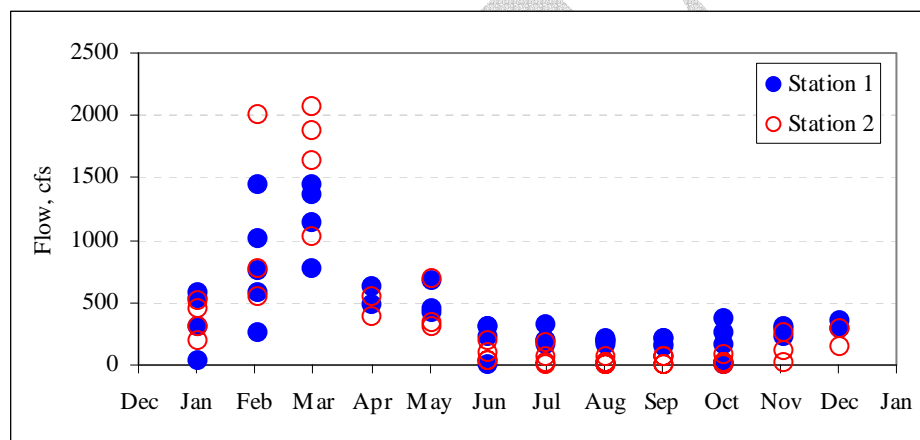


Figure 17. Flow pattern at mainstem Station 1 (RM 118.5) and Station 2 (RM 116.1)

The average flow during the Dec-Mar period at Stations 1 and 2 are 722 cfs and 906 cfs, respectively. Therefore the FC loads based on the existing 90th percentile concentrations (Table 3) are 5.1×10^{12} cfu/day and 5.6×10^{12} cfu/day, at Stations 1 and 2, respectively. The difference in the load (i.e. 0.5×10^{12} cfu/100 mL) is likely coming from Duffield Creek. However, this load is not significant in increasing the concentration of fecal coliform bacteria at Station 2 relative to Station 1. Whether this creates exceedence of the fecal coliform bacteria in Duffield Creek may be evaluated as follows:

Average flow in Duffield Creek (Dec-Mar) = $906 - 722 = 184$ cfs

The 90th percentile fecal coliform bacteria based on a loading of 0.5×10^{12} cfu/day = 111 cfu/100 mL

This, again, indicates that Duffield Creek is likely meeting the water quality standard.

The FC loads following achievement of the 90th percentile water quality standard at Station 1 (i.e., 30% reduction) and Station 2 (21% reduction) are 3.6×10^{12} cfu/day and 4.4×10^{12} cfu/day, respectively.

Middle NFPR (above Cedar Creek to below Silver Creek), RM 116.1 – RM 102.7

This segment is below the City of Palouse and includes the tributaries Cedar and Silver creeks. Two mainstem monitoring stations (one below Cedar the other below Silver creeks) and three tributary stations (two on Silver Creek and one on Cedar Creek) are located in this segment (Figure 18). The city of Garfield STP discharges to Silver Creek between two monitoring stations. Data from these stations and the STP are discussed below.

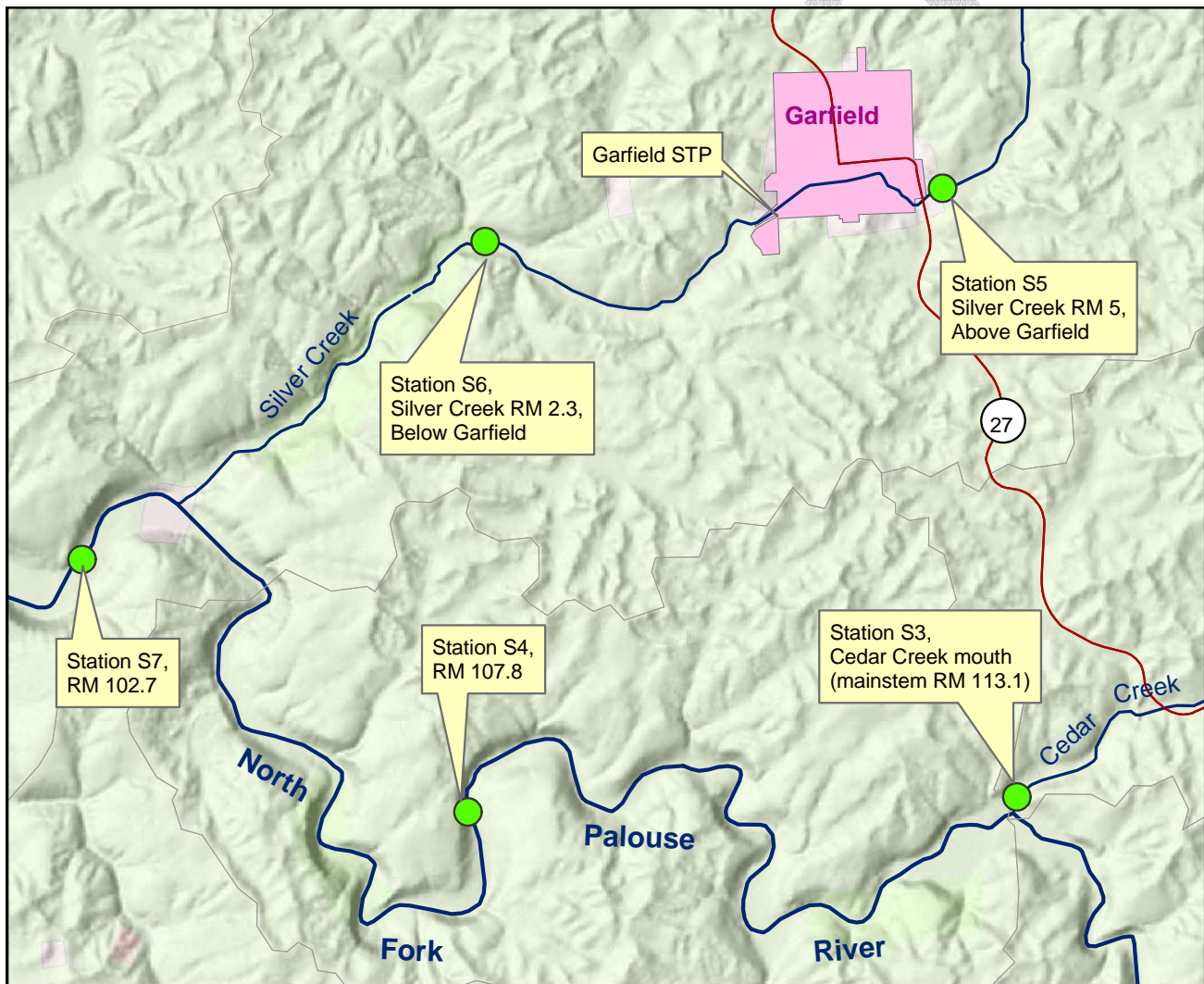
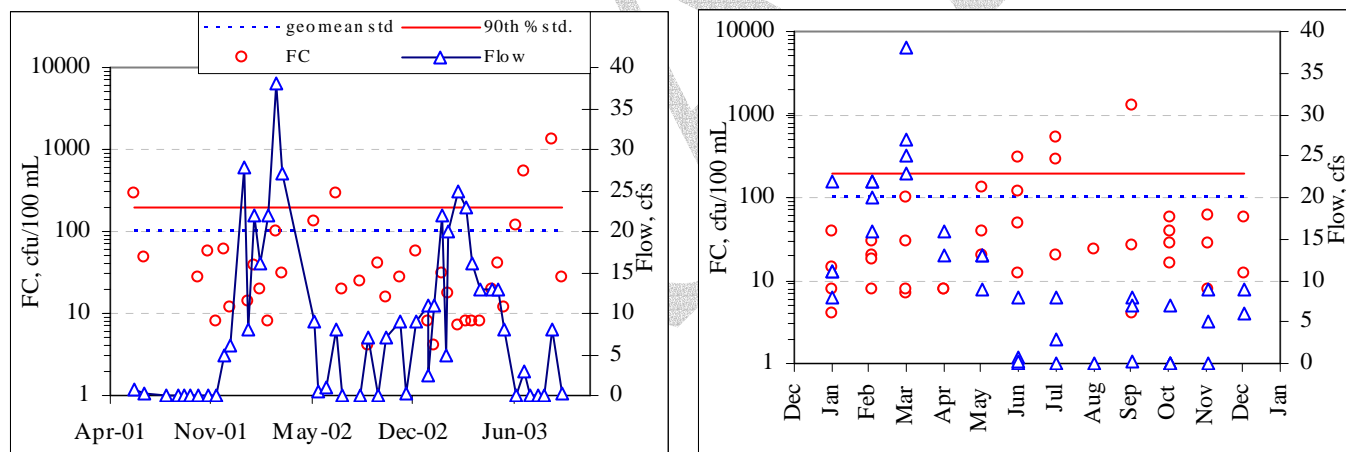


Figure 18. Locations of sampling stations and Garfield STP in the Middle NFPR segment

Cedar Creek (mouth at NFPR RM 113.1: Station 3)

Cedar Creek drains approximately 16,000 acres of primarily crop land. About 50% of the drainage area is in Latah County, Idaho. The other 50% of the drainage area is in Whitman County, Washington. The creek consists of 41 miles of intermittent stream, tributaries and water ways. The Cedar Creek watershed is 85% agricultural land, with an additional 14% used for grazing, and 1% urban area (Resource Planning Unlimited, Inc, 2002). The mouth of Cedar Creek is located at North Fork Palouse River RM 113.1.

The Palouse Conservation District measured both flow and fecal coliform bacteria concentrations at the mouth of Cedar Creek (Station 3) on a monthly basis between June, 2001 through September, 2003. Figure 19 shows the fecal coliform bacteria concentrations and flows during this period. Decreasing flows were associated with increased FC bacteria concentrations. High flows were observed during winter and spring while low flows were present in summer and fall seasons. Almost all of the high FC concentrations occurred in summer and early fall period with the highest concentrations observed in the month of September. To determine a seasonal target reduction the months of May through September were combined. Figure 20(a) shows the cumulative probability plot of data during this period. Figure 20(b) shows the distribution of the data. The 90th percentile concentrations exceeded the water quality standard of 200 cfu/100 mL. The target reduction is shown in Table 4.



(a) variation of FC and flow during the study period

(b) monthly variation in FC and flow

Figure 19. Fecal coliform bacteria concentrations at Station 3 in Cedar Creek (mouth).

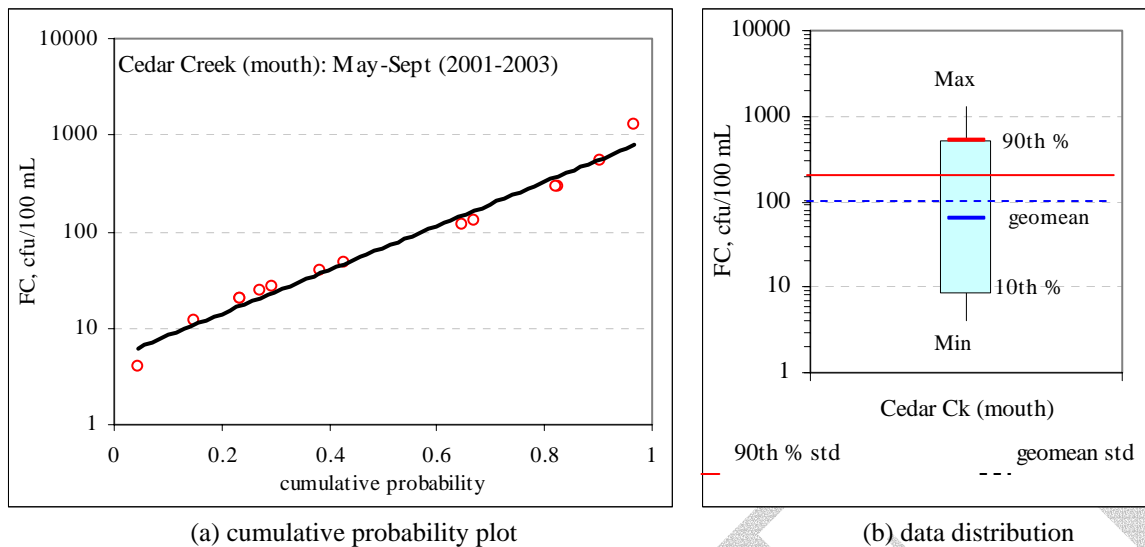


Figure 20. Cumulative probability and data distribution of fecal coliform bacteria concentrations (May-Sept, 2001-2003) in Cedar Creek mouth (Station 3)

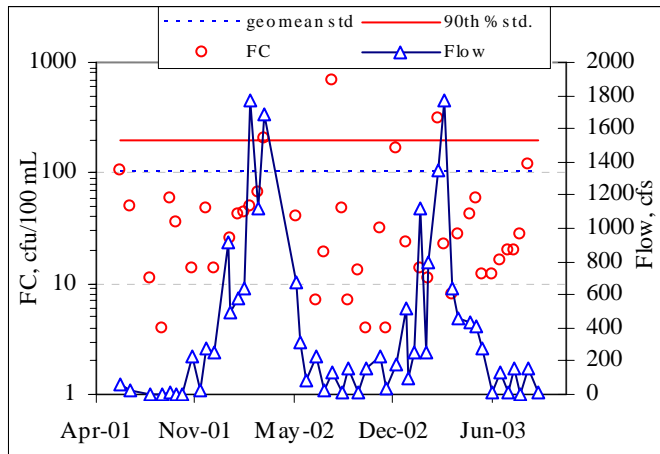
Table 4. Target fecal coliform concentration reductions for mouth of Cedar Creek

Period considered	Number of samples	Geometric Mean (cfu/100 mL)	90 th Percentile (cfu/100 mL)	Limiting basis for reduction	Target Reduction (%)
May-Sept	14	65	521	90 th percentile	62

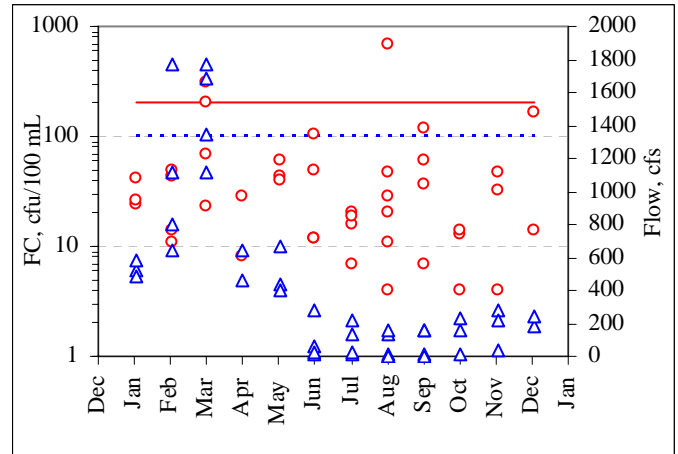
With an average flow of 5.9 cfs (May-Sept) and the 90th percentile concentration of 521 cfu/ 100 mL, the existing FC load at the mouth of Cedar Creek is 7.5×10^{10} cfu/day. The FC load following achievement of the water quality standard (i.e. 62% reduction) is 2.9×10^{10} cfu/day.

RM 107.8 (Lang Road Bridge: Station 4)

This station is located between Cedar and Silver creeks. The Palouse Conservation District measured fecal coliform bacteria concentrations at Station 4 (RM 107.8) on a monthly basis from August, 2001 through September, 2003. Figure 21 shows the fecal coliform bacteria concentrations and distribution during this period. High FC concentrations are associated with both low and high flows. High flows were observed during spring while low flows were present in summer and fall seasons. The highest concentrations were observed in the months of March and August. To determine a seasonal target reduction the periods of February-March and July-September were analyzed. Figure 22(a) shows the cumulative probability plot of data during these periods. For the July-Sept period, one data point was visibly outside the log-normal-cumulative-probability regression line. However, the square of the correlation coefficient, i.e. R^2 was 0.98 indicating a good fit. Figure 22(b) shows the distribution of the data within each of the two periods. The 90th percentile concentrations exceeded the water quality standard of 200 cfu/100 mL. The target reductions are shown in Table 5.

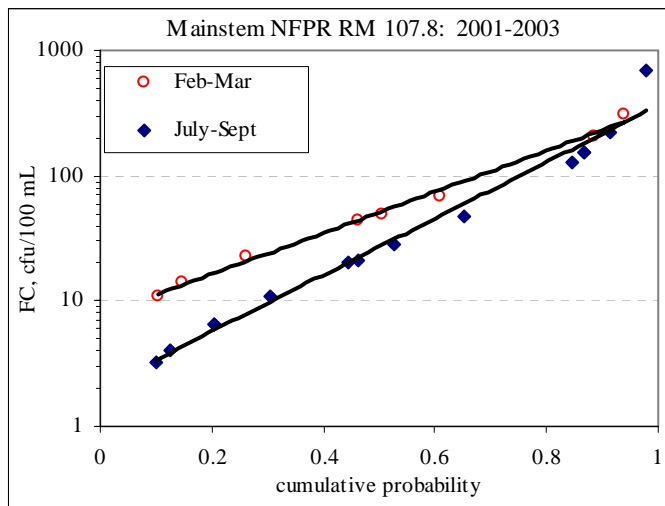


(a) variation of FC and flow during the study period

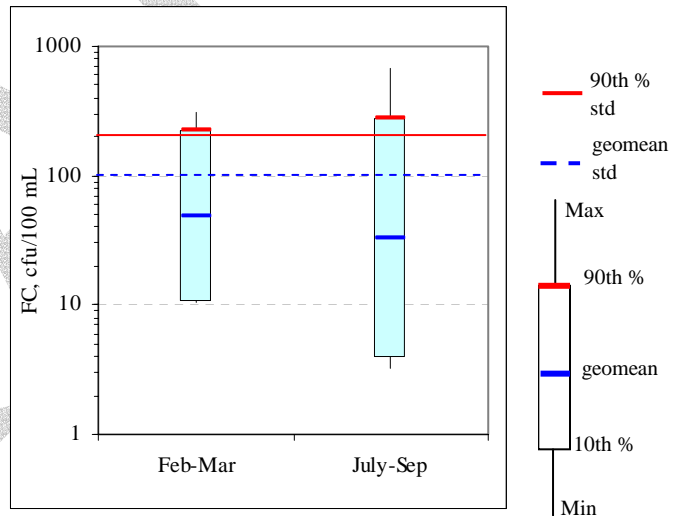


(b) monthly variation in FC and flow

Figure 21. Fecal coliform bacteria concentrations at mainstem NFPR RM 107.8



(a) cumulative probability plot



(b) data distribution

Figure 22. Cumulative probability plots and data distribution of fecal coliform bacteria concentrations at mainstem NFPR (RM 107.8)

Table 5. Target fecal coliform concentration reductions in mainstem NFPR at RM 107.8 (Station 4)

Station	Period considered	Number of samples	Geometric Mean (cfu/100 mL)	90 th Percentile (cfu/100 mL)	Limiting basis for reduction	Target Reduction (%)
RM 107.8	Feb-Mar	8	49	226	90 th percentile	12
	Jul-Sep	14	33	277	90 th percentile	28

The average flows in the Feb-Mar and Jul-Sep periods are 1281 cfs and 72 cfs, respectively. Therefore the loads based on the existing 90th percentile concentrations (Table 5) are 7.1×10^{12} cfu/day and 4.9×10^{11}

cfu/day, in Feb-Mar and Jul-Sep periods, respectively. After meeting the 90th percentile water quality standard, the FC loading would be 6.3×10^{12} and 3.5×10^{11} cfu/day, in the Feb-Mar and Jul-Sep periods, respectively. Since different sources may potentially exist during these two periods with distinctly different flow regimes, monitoring should be conducted in both the Feb- March and Jul-Sep periods.

Silver Creek (Mouth at NFPR RM 103.5: Stations 5 & 6)

Silver Creek drains approximately 28,500 acres of primarily crop land. About 17% of the drainage area is in Latah County, Idaho. The rest of the drainage area is in Whitman County, Washington. The creek consists of 3 miles of perennial stream and an additional 78 miles of intermittent stream, tributaries and water ways. The Silver Creek watershed is 77% agricultural land, with an additional 16% used for grazing, 2% urban area and 5% non-intensive use land (Resource Planning Unlimited, Inc, 2002). The mouth of Silver Creek is located at RM 103.5.

The Palouse Conservation District measured both flow and fecal coliform bacteria concentrations at two locations (station 5, Silver Creek RM 5 and station 6, Silver Creek RM 2.3) on a monthly basis from June, 2001 through September, 2003. Station 5 is above the Garfield Sewage Treatment Plant while station 6 is below.

Segment Above Garfield (RM 5)

Figure 23 shows the fecal coliform bacteria concentrations and flows at Station 5 (above Garfield) during the 2001-2003 study period. Decreasing flows generally tend to increase the FC bacteria concentrations. A few high FC concentrations were also observed during high flows. High flows were observed during spring while low flows were present in summer and early fall. Almost all of the high FC concentrations occurred in summer with the highest concentrations observed in the month of June. To determine a seasonal target reduction the months of May through August were combined. Figure 24(a) shows the cumulative probability plot of data during this period. Figure 24(b) shows the distribution of the data. The 90th percentile concentrations exceeded the water quality standard of 200 cfu/100 mL. The target reduction is shown in Table 6.

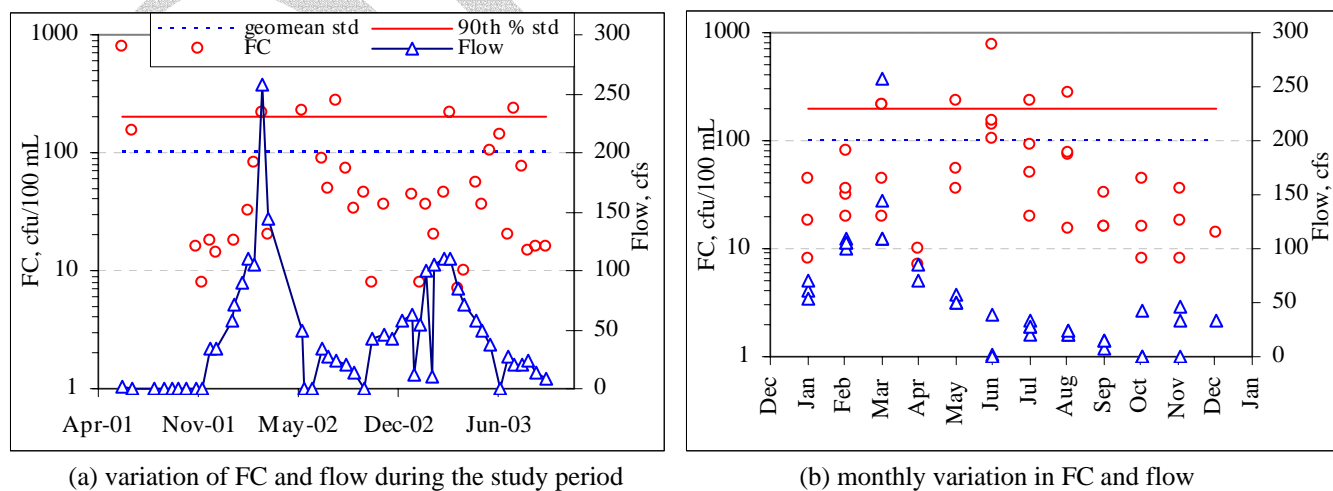


Figure 23. Fecal coliform bacteria concentrations in Silver Creek RM 5 (station 5)

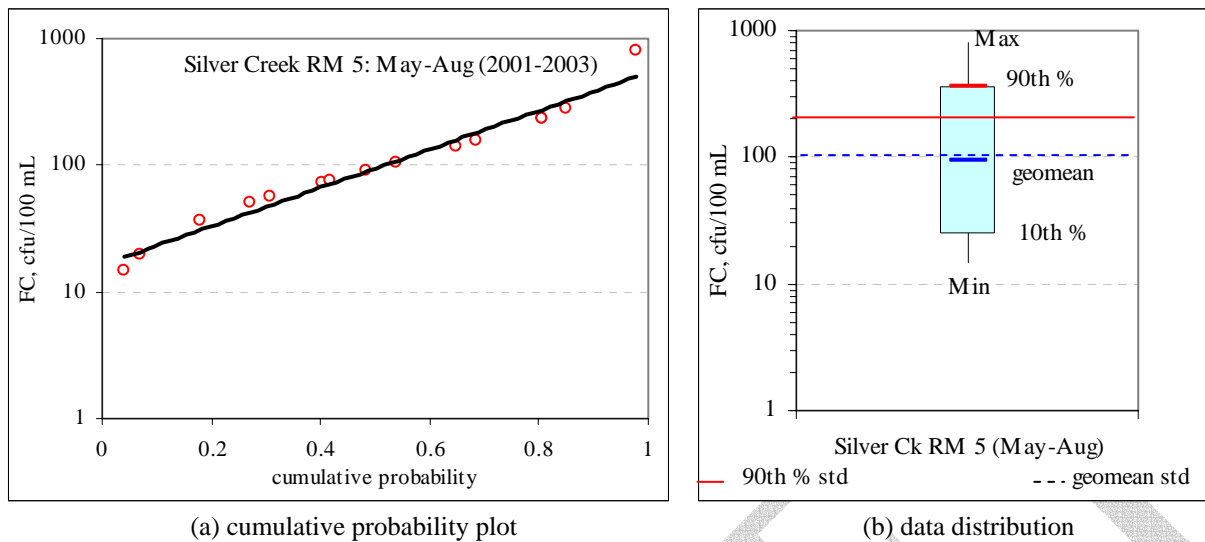


Figure 24. Cumulative probability and data distribution of fecal coliform bacteria concentrations (May-Aug, 2001-2003) in Silver Creek RM 5 (Station 5)

Table 6. Target fecal coliform concentration reductions for Silver Creek segment above RM 5

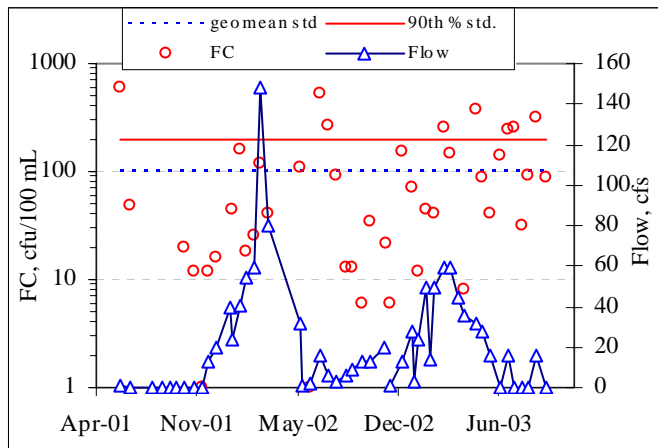
Period considered	Number of samples	Geometric Mean (cfu/100 mL)	90 th Percentile (cfu/100 mL)	Limiting basis for reduction	Target Reduction (%)
May-Aug	15	94	357	90 th percentile	44

It should be noted that elevated concentrations of FC bacteria were also observed in March when flows were high. This may indicate a different source of bacteria compared to the low flow conditions. Future monitoring in the month of March is recommended.

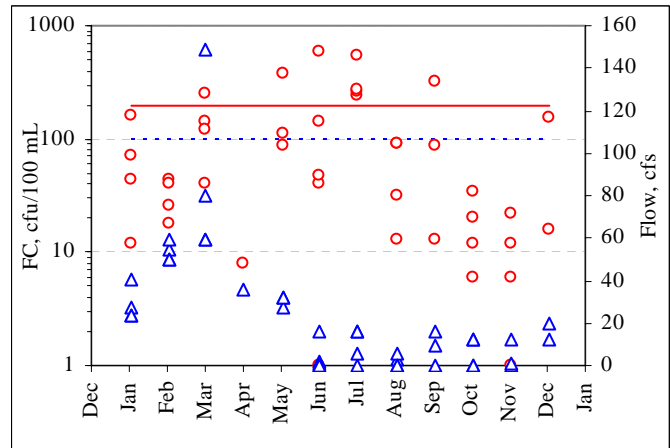
With an average flow of 26.4 cfs (May – Aug), and the 90th percentile concentration of 357 cfu/ 100 mL, the existing FC load at RM 5 of Silver Creek (i.e. above Garfield), is 2.3×10^{11} cfu/day. The FC load following achievement of water quality standard (i.e. 44% reduction) is 1.3×10^{11} cfu/day.

Segment Below Garfield (RM 2.3)

Figure 25 shows the fecal coliform bacteria concentrations and flows at Station 6 (RM 2.3 below Garfield) during the 2001-2003 study period. Again, decreasing flows were generally associated with increasing FC bacteria concentrations. A few high FC concentrations were also observed during high flows. Higher flows were observed during winter and spring while low flows were present in summer and fall. Almost all of the high FC concentrations occurred in summer with the highest concentrations observed in the month of June. To determine a seasonal target reduction the months of May through September were combined. Figure 26(a) shows the cumulative probability plot of data during this period. Figure 26(b) shows the distribution of the data. Both the geometric mean and the 90th percentile concentrations exceeded the water quality standards. The target reduction is shown in Table 7.

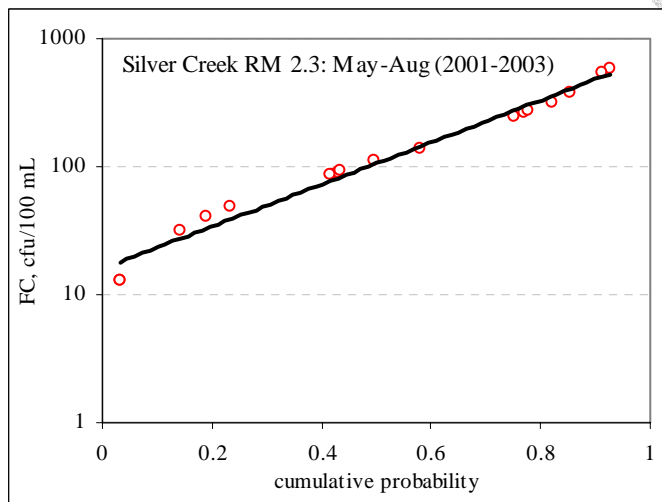


(a) variation of FC and flow during the study period

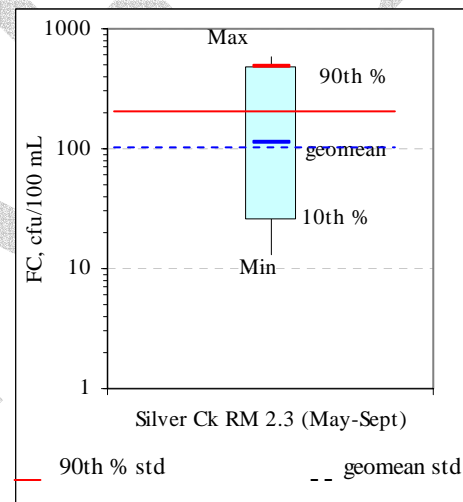


(b) monthly variation in FC and flow

Figure 25. Fecal coliform bacteria concentrations in Silver Creek RM 2.3 (station 6)



(a) cumulative probability plot



(b) data distribution

Figure 26. Cumulative probability and data distribution of fecal coliform bacteria concentrations (May-Aug, 2001-2003) in Silver Creek RM 2.3 (Station 6)

Table 7. Target fecal coliform concentration reductions for Silver Creek segment (RM 2.3)

Period considered	Number of samples	Geometric Mean (cfu/100 mL)	90 th Percentile (cfu/100 mL)	Limiting basis for reduction	Target Reduction (%)
May-Sept	18	111	488	90 th percentile	59

Similar to Station 5, elevated concentrations of FC bacteria were also observed at Station 6 (RM 2.3) in March when flows were high. This may indicate a different source of bacteria compared to the low flow conditions (May-Sept). Future monitoring in the month of March is recommended.

With an average flow of 12 cfs (May – Sept) and the 90th percentile concentration of 488 cfu/ 100 mL, the existing FC load at RM 2.3 of Silver Creek (i.e. below Garfield), is 1.4×10^{11} cfu/day. The FC load following achievement of water quality standard (i.e. 59 % reduction) is 5.9×10^{10} cfu/day.

City of Garfield Municipal Wastewater Treatment Plant (WWTP)

The facility was issued NPDES permit No. WA-004482-2 in 2000. The permit contains effluent limits for fecal coliform bacteria at 100 cfu/100 mL as both monthly and weekly geometric means. This is equivalent to meeting the water quality standards at “end-of-pipe.” In addition, the facility has a 300-ft mixing zone at its outfall in Silver Creek with a dilution factor of 1.03 at the edge of the chronic zone. The loading from the plant based on a maximum monthly design flow of 0.07 MGD is 5.3×10^8 cfu/day. Evaluation of monthly discharge monitoring reports over the last year (2003) showed that the mean fecal coliform concentrations have been consistently below 30 cfu/100 mL. Evaluation of monthly discharge monitoring reports over the last three years (2001-2003) showed 100% compliance with the monthly geometric mean limit and 97% compliance with the weekly geometric mean limit (Figure 27).

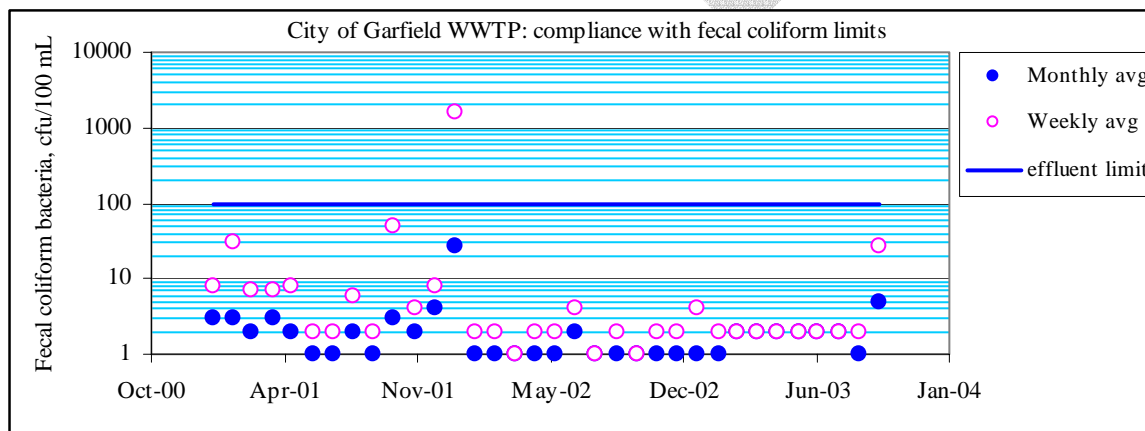
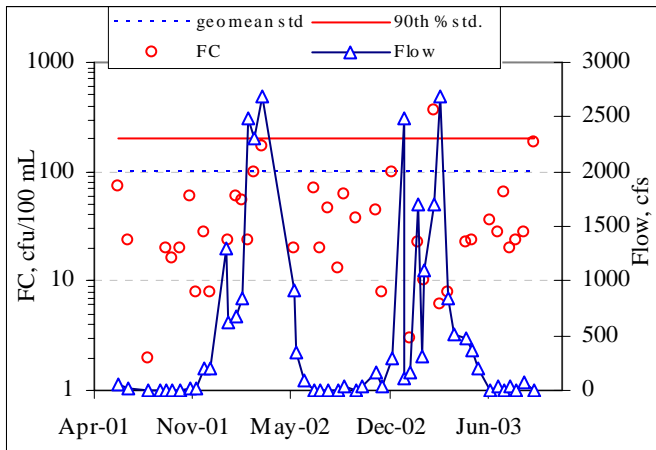


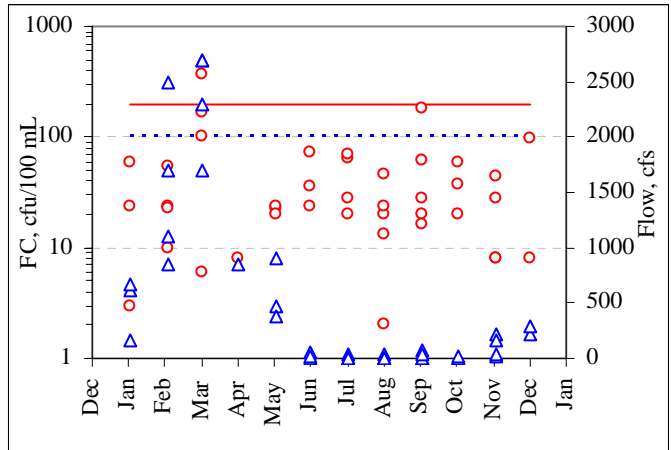
Figure 27. Fecal coliform concentrations in City of Garfield WWTP effluent (2001-2003)

RM 102.7 (Elberton Road: Station 7)

This station is located in the mainstem NF Palouse River between Silver and Clear creeks. The Palouse Conservation District measured fecal coliform bacteria concentrations and flow at Station 7 (RM 102.7) on a monthly basis from August, 2001 through September, 2003. Figure 28 shows the fecal coliform bacteria concentrations and distribution during this period. High FC concentrations are associated with high flows. High flows were observed during spring while low flows were present in summer and fall seasons. To determine a seasonal target reduction, the period of February-March was selected due to similarity in flow. Figure 29(a) shows the cumulative probability plot of data during this period. Figure 29(b) shows the distribution of the data within each of the two periods. The 90th percentile concentrations exceeded the water quality standard of 200 cfu/100 mL. The target reduction is shown in Table 8.

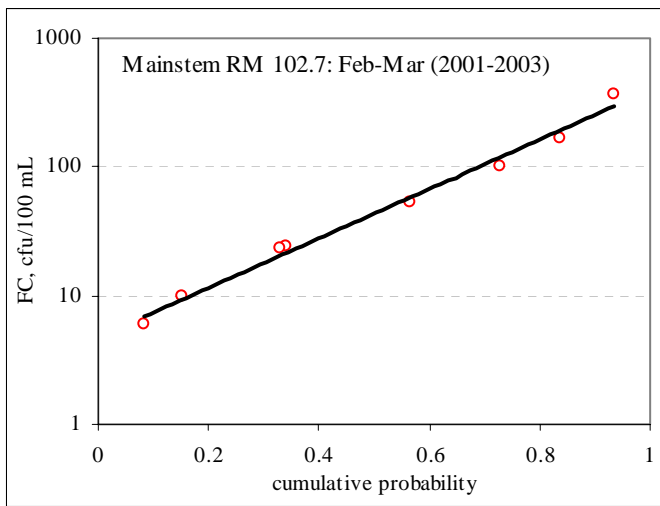


(a) variation of FC and flow during the study period

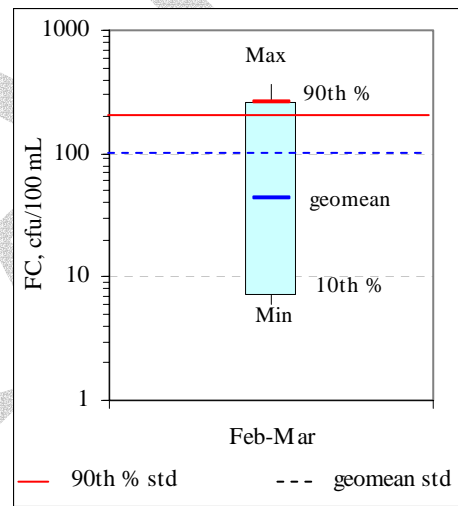


(b) monthly variation in FC and flow

Figure 28. Fecal coliform bacteria concentrations in mainstem NFPR RM 102.7



(a) cumulative probability plot



(b) data distribution

Figure 29. Cumulative probability and data distribution of fecal coliform bacteria concentrations (May-Aug, 2001-2003) in mainstem NFPR RM 102.7 (Station 7)

Table 8. Target fecal coliform concentration reductions in the mainstem NFPR at RM 102.7 (Station 7)

Station	Period considered	Number of samples	Geometric Mean (cfu/100 mL)	90 th Percentile (cfu/100 mL)	Limiting basis for reduction	Target Reduction (%)
RM 107.8	Feb-Mar	8	43	261	90 th percentile	53

The average flows in the Feb-Mar period (2001-2003) was 1936 cfs. Therefore the FC load based on the 90th percentile concentration (Table 8) is 1.2×10^{13} cfu/day. After meeting the 90th percentile water quality standard, the loading in Feb-Mar would be 9.5×10^{12} cfu/day.

Lower NFPR, below Silver Creek to mouth of NFPR: RM 102.7 – RM 89.6

This is a 13 mile segment extending from the confluence of the North and South Fork Palouse River (RM 89.6) to just below Silver Creek (RM 102.7). Clear Creek, a tributary to the NFPR, is located at RM 96.2. There are three mainstem monitoring stations located between Clear Creek and the mouth of NFPR (Figure 30). Data from these stations are discussed below.

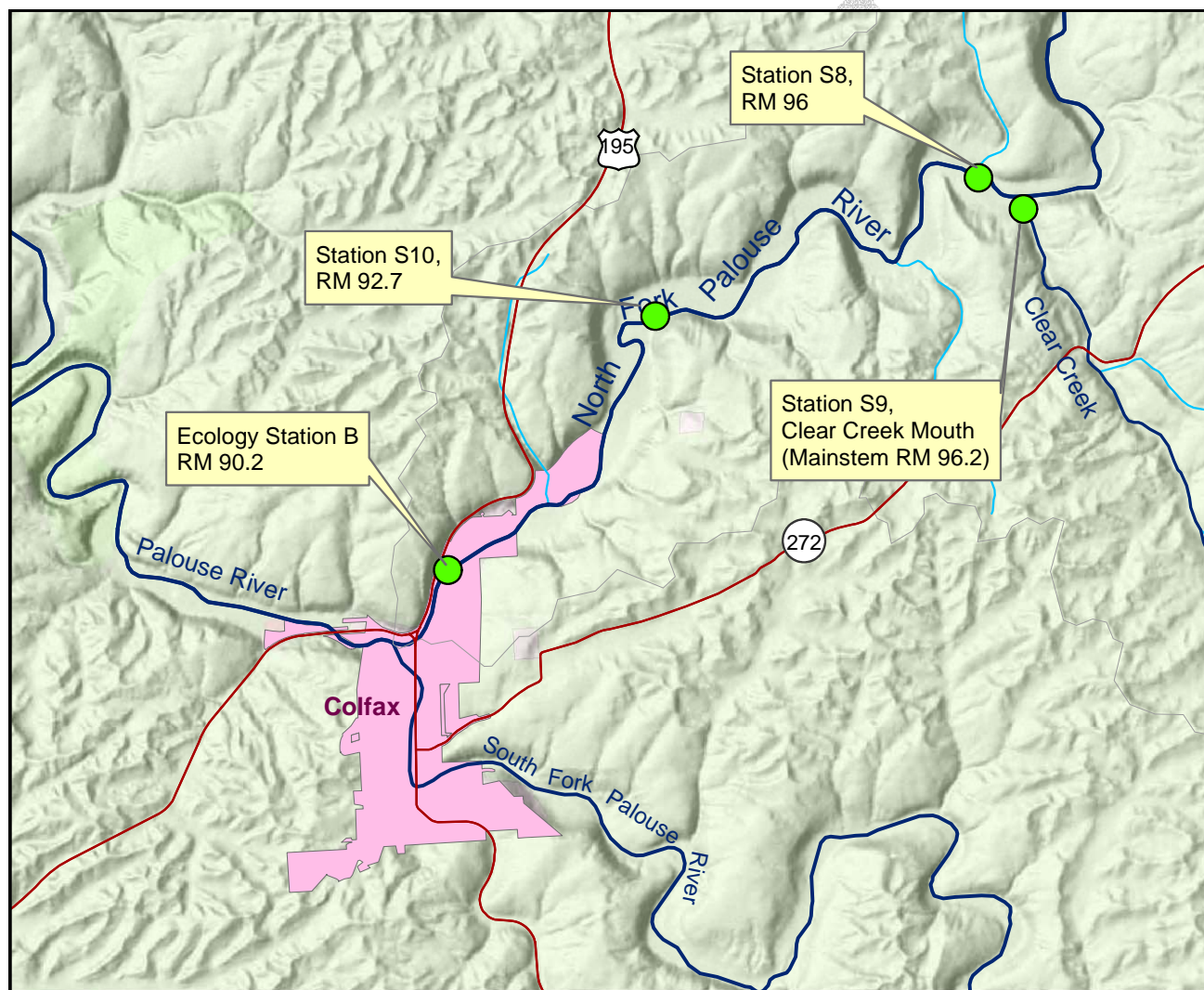


Figure 30. Locations of sampling stations in the Lower NFPR segment

Clear Creek (Mouth at NFPR RM 96.2: Station 9)

Clear Creek drains approximately 12,400 acres of primarily crop land in Whitman County, Washington. The creek consists of 2 miles of perennial stream and an additional 43 miles of intermittent stream, tributaries and water ways. The Clear Creek watershed is 92% agricultural land, with an additional 5% used

for grazing, 1% urban area and 2% non-intensive use land (Resource Planning Unlimited, Inc, 2002). The mouth of Clear Creek is located at North Fork Palouse River, RM 96.2.

The Palouse Conservation District measured both flow and FC bacteria concentrations at the mouth of Clear Creek (Station 9) on a monthly basis between June, 2001 and September, 2003. Figure 31 shows the fecal coliform concentrations and flows during this period. Decreasing flows tend to increase the FC bacteria concentrations. However, a few high FC concentrations were also observed during high flows. High flows were observed during winter and spring while low flows were present in summer and fall seasons. Almost all of the high FC concentrations occurred in summer and early fall periods with the highest concentrations observed in the month of October. Due to similarity of flow, the months of June through October were combined to estimate the target reductions necessary at the mouth of Clear Creek. Similarly, the months of February and March were combined to estimate a target reduction. Figure 32(a) shows the cumulative probability plot of data during these periods. For the June-Oct period, one data point was visibly outside the log-normal-cumulative-probability regression line. However, the square of the correlation coefficient, i.e. R^2 was 0.94 indicating a good fit. Figure 32(b) shows the distribution of the data. Both the geometric mean and the 90th percentile concentrations exceeded the respective water quality standards during the June-October period, while only the 90th percentile exceeded the standard in the February –March period. The target reductions are shown in Table 9.

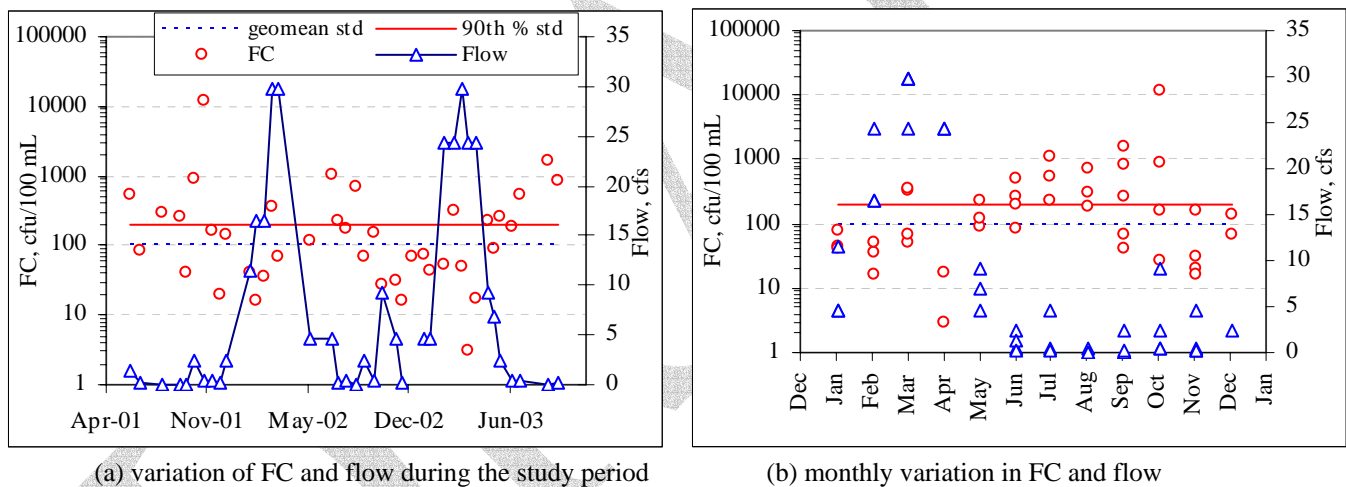


Figure 31. Fecal coliform bacteria concentrations at the mouth of Clear Creek (station 9)

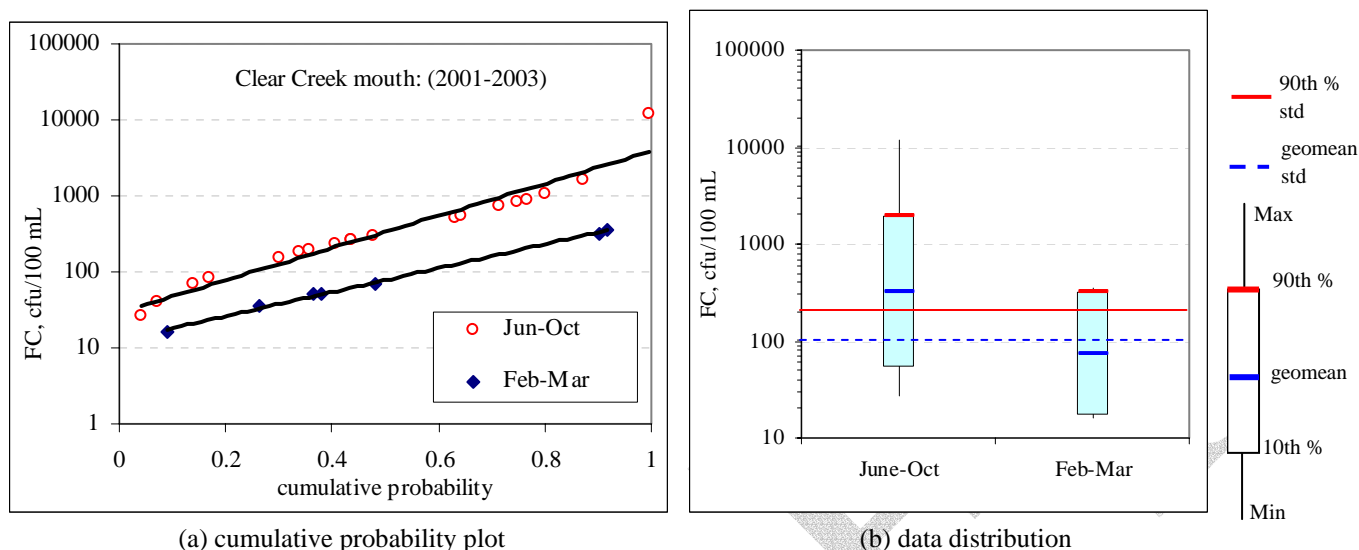


Figure 32. Cumulative probability and data distribution of fecal coliform bacteria concentrations (2001-2003) at mouth of Clear Creek (Station 9)

Table 9. Target fecal coliform concentration reductions at the mouth of Clear Creek

Period considered	Number of samples	Geometric Mean (cfu/100 mL)	90 th Percentile (cfu/100 mL)	Limiting basis for reduction	Target Reduction (%)
June- October	19	323	1986	90 th percentile	90
Feb-Mar	7	74	319	90 th percentile	37

The average flow in the Jun-Oct and Feb-Mar periods (2001-2003) are 1.4 cfs and 24 cfs, respectively. Using the 90th percentile concentrations in Table 9, the existing FC load at the mouth of Clear Creek is 6.8×10^{10} cfu/day and 1.9×10^{11} cfu/day for the Jun-Oct and Feb-Mar periods, respectively. The FC load following achievement of water quality standard is 6.8×10^9 cfu/day (i.e. 90% reduction) and 1.2×10^{11} cfu/day (i.e. 37% reduction) for Jun-Oct and Feb-Mar periods, respectively.

RM 96 (Glenwood Road: Station 8)

Station 8 (RM 96) is located right below Clear Creek (RM 96.2). The Palouse Conservation District measured fecal coliform bacteria concentrations and flow at this station on a monthly basis from August, 2001 through September, 2003. Figure 33 shows the fecal coliform bacteria concentrations and flow during this period. High FC concentrations are associated with both low and high flows. High flows were observed during spring while low flows were present in summer and fall seasons. The highest FC concentrations were observed in the month of March. To determine a seasonal FC target reduction the period of February-March was chosen due to similarity in flow regime. Figure 34 (a) shows the cumulative

probability plot of data during this period. Figure 34(b) shows the distribution of the data within this period. The 90th percentile concentrations exceeded the water quality standard of 200 cfu/100 mL. The target reduction is shown in Table 10.

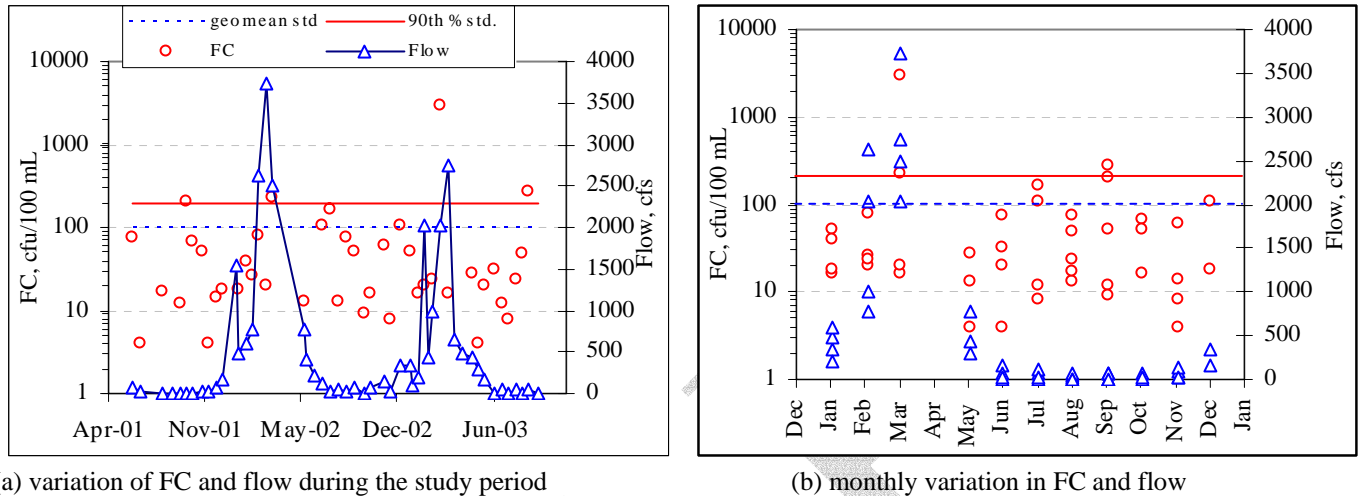


Figure 33. Fecal coliform bacteria concentrations in mainstem NFPR RM 96 (Station 8)

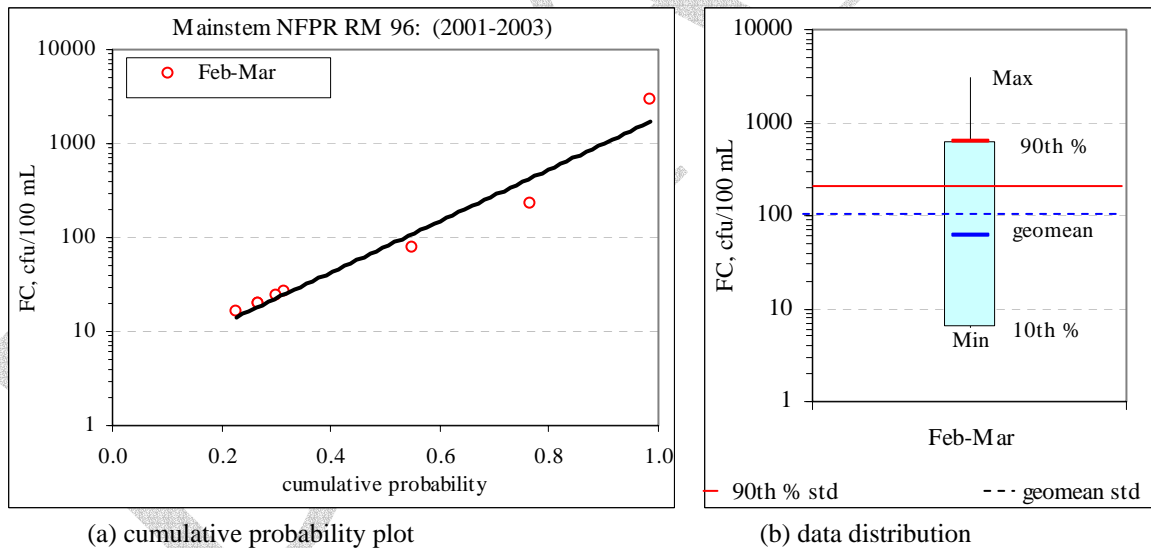


Figure 34. Cumulative probability and data distribution of fecal coliform bacteria concentrations (Feb-Mar, 2001-2003) in mainstem NFPR RM 96 (Station 8)

Table 10. Target fecal coliform concentration reductions in the mainstem NFPR at RM 96 (Station 8)

Station	Period considered	Number of samples	Geometric Mean (cfu/100 mL)	90 th Percentile (cfu/100 mL)	Limiting basis for reduction	Target Reduction (%)
RM 96	Feb-Mar	8	62	629	90 th percentile	68

The average flows in the Feb-Mar period (2001-2003) was 2177 cfs. Therefore the FC load based on the 90th percentile concentration (Table 10) is 3.4×10^{13} cfu/day. After meeting the 90th percentile water quality standard, the loading in the Feb-Mar period would be 1×10^{13} cfu/day.

RM 92.7 (at the Old USGS gage: Station 10)

Station 10 (RM 92.7) is located almost half way between Clear Creek (RM96.2) and the confluence of the NF and SF Palouse Rivers (RM 89.6). The Palouse Conservation District measured fecal coliform bacteria concentrations at this station on a monthly basis from August, 2001 through September, 2003. No flow was measured. However, due to close proximity to Station 8 (RM 96), it is assumed that the flow at Station 10 (RM 92.7) and Station 8 (RM 96) are similar. Figure 35 shows the fecal coliform concentrations and estimated flow during the study period. High FC concentrations are associated with both low and high flows. High flows were observed during spring while low flows were present in summer and fall seasons. The highest FC concentrations were observed in the month of March. To determine a seasonal FC target reduction, the period of February-March was chosen due to similarity in flow regime. Figure 36(a) shows the cumulative probability plot of data during this period. Figure 36(b) shows the distribution of the data within this period. The 90th percentile concentrations exceeded the water quality standard of 200 cfu/100 mL. The target reduction is shown in Table 11. This is similar to the target reduction estimated for Station 8 (RM 96).

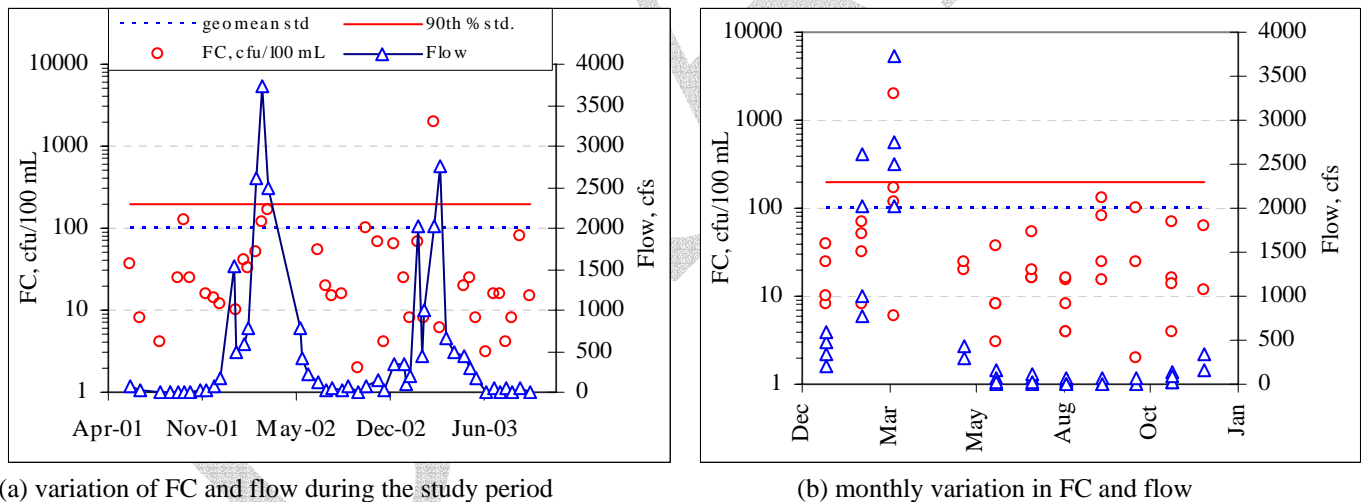


Figure 35. Fecal coliform bacteria concentrations in mainstem NFPR RM 92.7 (Station 10)

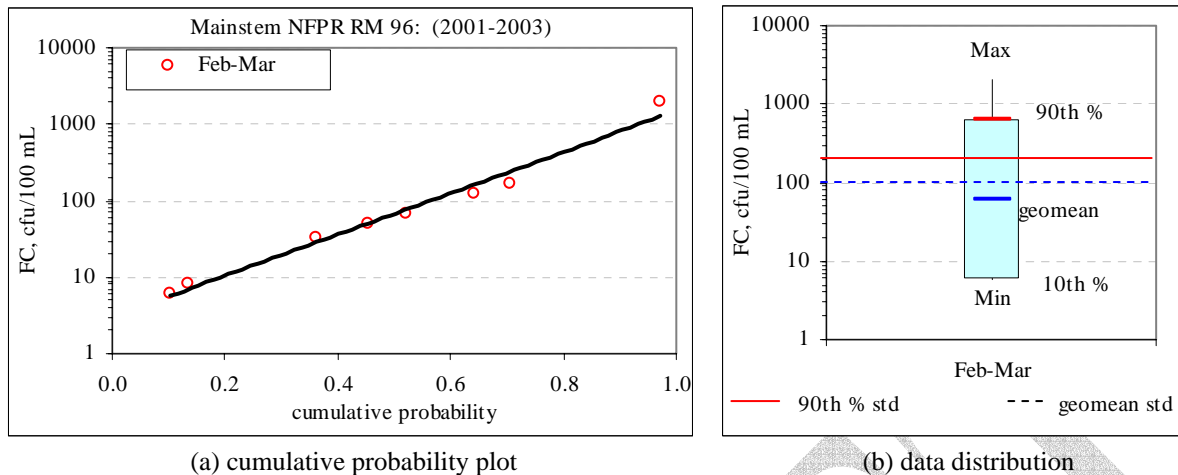


Figure 36. Cumulative probability and data distribution of fecal coliform bacteria concentrations (Feb-Mar, 2001-2003) in mainstem NFPR RM 92.7 (Station 10)

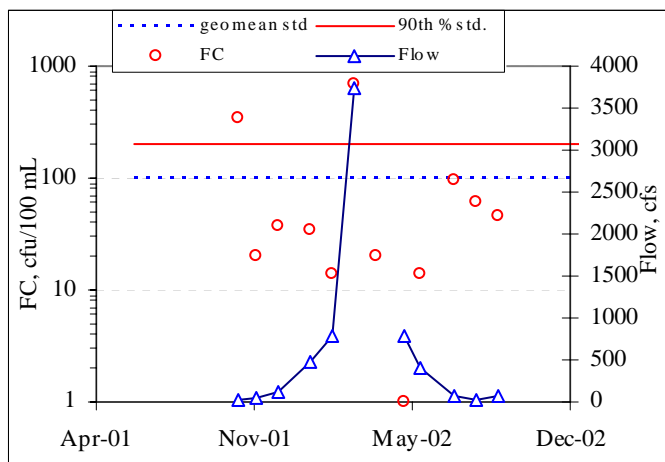
Table 11. Target fecal coliform concentration reductions in the mainstem NFPR at RM 92.7 (Station 10)

Station	Period considered	Number of samples	Geometric Mean (cfu/100 mL)	90 th Percentile (cfu/100 mL)	Limiting basis for reduction	Target Reduction (%)
RM 92.7	Feb-Mar	8	62	650	90 th percentile	69

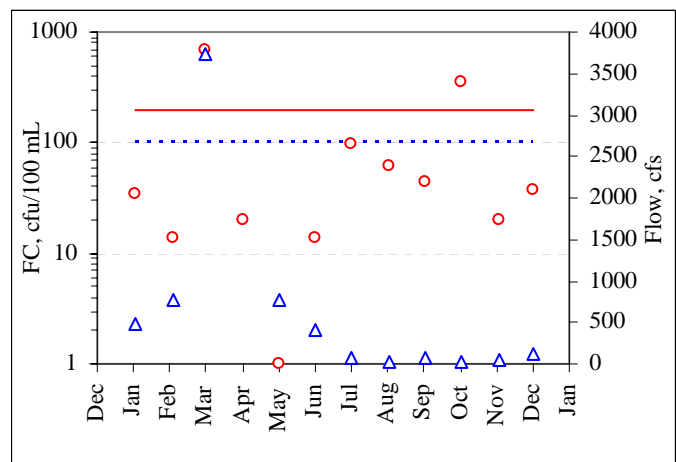
The average estimated flow in the Feb-Mar period (2001-2003) was 2177 cfs. Therefore the FC load based on the 90th percentile concentration (Table 11) is 3.5×10^{13} cfu/day. After meeting the 90th percentile water quality standard, the loading in the Feb-Mar period would be 1×10^{13} cfu/day.

RM 90.2: Near Colfax (Ecology Station B)

Ecology Station B (RM 90.2) is located near the town of Colfax, right above the confluence of the north and south forks of the Palouse River. Ecology measured fecal coliform bacteria concentrations at this station on a monthly basis from October, 2001 through September, 2002. No flow was measured. However, due to close proximity to Station 10 (RM 92.7) and Station 8 (RM 96), it is assumed that the flow at Ecology Station B is similar to the other two stations. Figure 37 shows the fecal coliform bacteria concentrations and flow during the study period. High FC concentrations are associated with both low and high flows. High flows were observed during spring while low flows were present in summer and fall seasons. The highest FC concentrations were observed in the month of March. A seasonal evaluation could not be done due to insufficient data. Therefore an annual FC target reduction was estimated. Figure 38(a) shows the cumulative probability plot of data during this period. Figure 38(b) shows the distribution of the data within this period. The 90th percentile concentrations exceeded the water quality standard of 200 cfu/100 mL. The target reduction is shown in Table 12. It should be noted that the 90th percentile concentrations (137 cfu/100 mL and 109 cfu/100 mL) at Station 8 and Station 10 during the same period (i.e. 2001-2002 period) were much lower than that at Ecology station B. This is likely due to additional sources between station 10 (RM 92.7) and Ecology station B (RM 90.2). Monitoring should be continued at this station following implementation of BMPs.

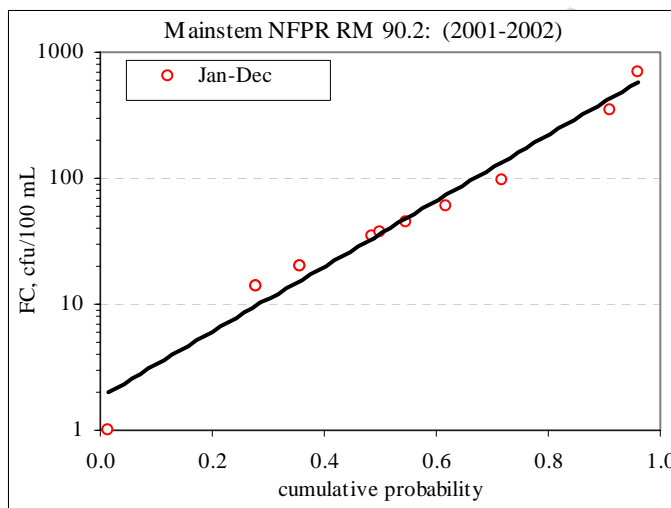


(a) variation of FC and flow during the study period

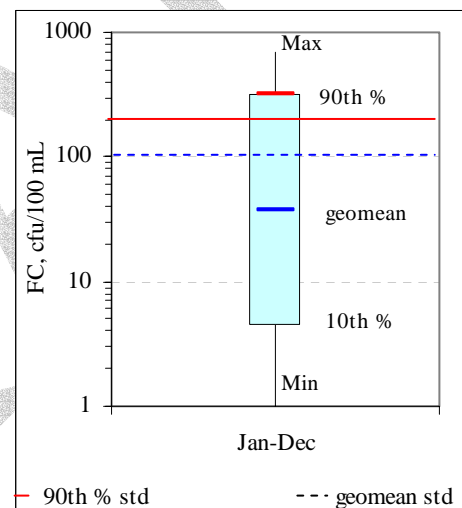


(b) monthly variation in FC and flow

Figure 37. Fecal coliform bacteria concentrations in mainstem NFPR RM 90.2 (Ecology Station B)



(a) cumulative probability plot



(b) data distribution

Figure 38. Cumulative probability and data distribution of fecal coliform bacteria concentrations (Jan-Dec, 2001-2002) in mainstem NFPR RM 90.2 (Ecology station B)

Table 12. Target fecal coliform concentration reductions in the mainstem NFPR at RM 90.2 (Ecology Station B)

Station	Period considered	Number of samples	Geometric Mean (cfu/100 mL)	90 th Percentile (cfu/100 mL)	Limiting basis for reduction	Target Reduction (%)
RM 90.2	Annual	12	37	313	90 th percentile	36

With an annual average flow of 594 cfs, loading at the existing 90th percentile concentration (Table 12) is 4.5×10^{12} cfu/day. After meeting the 90th percentile water quality standard, the annual average loading would be 2.9×10^{12} cfu/day.

Loading Capacity Summary

“Loading Capacity” means the maximum amount of pollution a waterbody can withstand and still fulfill beneficial uses (i.e. meet state water quality standards). If the individual tributaries and the various segments upstream of any mainstem location were to meet the water quality standard then it is assumed that the water quality standard will be met at this mainstem location. Individual loading capacities for the tributaries and the mainstem are summarized in Table 12.

Table 13. Summary of target load reductions necessary to comply with FC water quality standards

Site		Loading capacity (cfu/day)	target reduction %	Basis	Critical period
<u>Upper NFPR (Border to Duffield Creek), RM 123.9 – RM116.1</u>					
Mainstem RM 121.2: Station Ecology A		$6 \times 10^{10*}$	80*	90 th % std	August
City of Palouse WWTP		2.1×10^9	no further reduction required		
Mainstem RM 118.5, Station 1		3.6×10^{12}	30	90 th % std	Dec-Mar
Duffield Creek at mouth (NFPR RM 116.3)	intermittent stream		no reduction required		
mainstem RM 116.1, Station 2		4.4×10^{12}	21	90 th % std	Dec-Mar
<u>Middle NFPR (Duffield Creek to Silver Creek), RM 116.1 – RM 102.7</u>					
Cedar Creek at mouth (NFPR RM 113.1), Station 3		2.9×10^{10}	62	90 th % std	May-Sept
Mainstem RM107.8, Station 4	Feb-Mar	7.2×10^{12}	12	90 th % std	Feb-Mar
	Jul-Sep	2.5×10^{11}	28	90 th % std	Jul-Sep
Silver Creek					
RM 5		1.3×10^{11}	44	90 th % std	May-Aug
City of Garfield WWTP		5.3×10^8	no further reduction required		
RM 2.3		5.3×10^{10}	59	90 th % std	May-Sept
Mainstem RM102.7, Station 7		9.5×10^{12}	53	90 th % std	Feb-Mar
<u>Lower NFPR (Silver Creek to mouth of NFPR), RM 102.7 – RM 89.6</u>					
Clear Creek at mouth (NFPR RM 96.2), Station 9					
	June-Oct	6.8×10^9	90	90 th % std	June-Oct
	Feb-Mar	1.2×10^{11}	37	90 th % std	Feb-Mar
Mainstem RM 96, Station 8		1×10^{13}	68	90 th % std	Feb-Mar
Mainstem RM 92.7, Station 10		1×10^{13}	69	90 th % std	Feb-Mar
Mainstem RM 90.2, Ecology Station B		$2.9 \times 10^{12**}$	36**	90 th % std	Annual
* based on long-term data					
** annual average basis					

Margin of Safety

The margin of safety for this TMDL is implicit through the use of conservative assumptions, summarized below.

The target reductions recommended in this report for the various segments of the mainstem North Fork Palouse River and its tributaries are based on observed FC concentrations. Compliance with the water quality standards will ultimately be achieved through BMP implementation and a follow-up monitoring plan. However, it is likely that BMPs may reduce bacteria concentrations in excess of the target reductions. For example, if a source of high bacterial concentration is completely eliminated, higher reduction of bacteria than the target may result.

The estimated targets do not account for any bacterial die-off in the water column or during travel from the source to the stream. As sources are removed from the stream, bacterial travel time from the source to the stream during a storm event would increase. This would allow for greater exposure of the bacteria to the environment and potential die-off.

Target reductions were based upon seasonal evaluations where sufficient data were available. BMPs based upon seasonal targets will substantially reduce the annual load at the various segments and tributaries.

The target reductions were based upon a 90th percentile of FC distributions which takes into account the variability of the data. This is more conservative than the 10th percentile water quality criterion which allows for 10% of the samples to exceed the criterion without considering the distribution of the data.

Monitoring Strategy

The North Fork Palouse River watershed consists of several segments and tributaries that do not meet the state standard for fecal coliform bacteria. To address the listings in a comprehensive manner the following monitoring strategy is recommended:

- Use the highest reduction targets to prioritize where resources should be first invested.
- Begin implementation of the BMPs first at the most upstream segment, tributary, or sub-tributary. Monitoring should follow wherever BMPs are implemented.
- As the segment, tributary, or sub-tributary with the worst problem is brought in compliance with water quality standards, the monitoring station should be moved to a less severe area where the next set of BMPs would be implemented.

Ongoing monitoring of water quality trends and activity implementation is essential in order to:

- show where water quality is improving,
- help locate sources of pollution,
- help indicate effectiveness of cleanup activities, and
- document achievement of compliance with state water quality standards.

A comprehensive monitoring plan will be included in the Detailed Implementation Plan for the NFPR, to be developed within one year of the date of approval of this TMDL.

If ambient or other monitoring data shows that progress towards targets is not occurring or if targets are not being met, compliance water quality monitoring will occur. Compliance monitoring will be designed to verify preliminary data and then identify the specific sources of fecal coliform loading. Sampling over time will be adjusted to locate the source by narrowing the geographic area where contamination is occurring.

Tributaries

In general, mouths of tributaries should be monitored so that the overall effects of BMPs implemented in the tributary can be evaluated.

- Clear Creek should be monitored both in summer/early fall (June-October) and spring (February-March) seasons.
- Cedar Creek should be monitored from May through September.
- Duffield Creek should be initially monitored annually for both flow and fecal coliform bacteria.
- Silver Creek should be monitored during the months of May through August and in the month of March. Concentrations of fecal coliform bacteria measured at Silver Creek RM 5 (Station 5) likely reflect contributions by non-point sources. However, the increase in fecal coliform bacteria between RM 5 (Station 5) and RM2.3 (Station 6) is likely from urban sources. The city of Garfield is between these two stations. Lack of flow may also play a role in the observed elevated fecal coliform concentrations at Station 6 (flow at Station 6 is lower than that at Station 5, Figure 36). Both Stations 5 and 6 should be monitored during and following BMP implementation. In addition to monitoring during the months of May through September, the month of March should also be monitored since elevated fecal coliform concentrations were observed in this month.

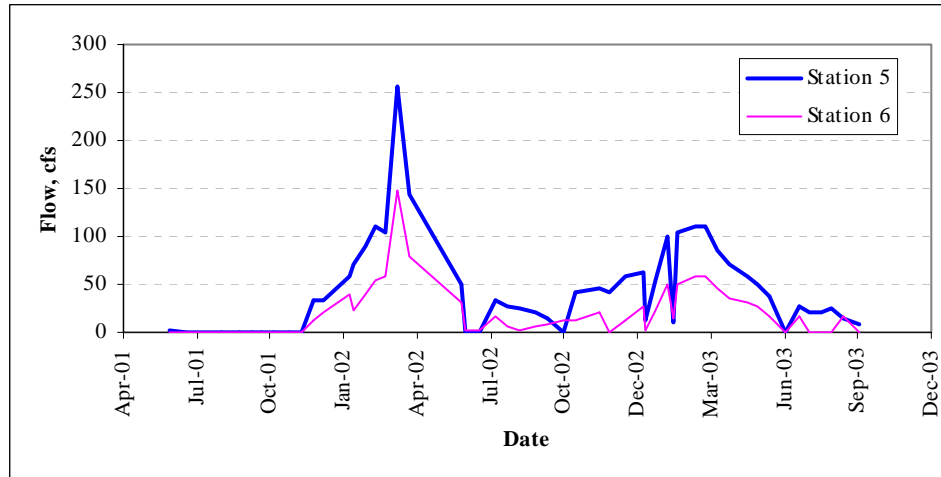


Figure 39. Flow at Station 5 and Station 6 in Silver Creek.

Mainstem

In general, monitoring locations and periods for the mainstem should follow those presented in Table 13. However, Station 11 (RM 123.9 at the Washington/Idaho border) should be continued to be monitored monthly. Data collected at this station should be evaluated to establish the need for BMP implementation above the state-line.

The number of monitoring stations can now be reduced. For example, only one station (i.e. Ecology Station B, RM 90.2) is necessary between Clear Creek and the mouth of NFPR in Colfax, unless there are specific reasons for establishing additional stations.

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